MACHINERY

DESIGN — CONSTRUCTION — OPERATION

Volume 37 . AUGUST, 1931 Number 12

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Total Distribution for July, 16,852 Copies

Product Index 182-198 Advertisers Index 201-202

PUBLISHED MONTHLY BY

THE INDUSTRIAL PRESS, 140-148 LAFAYETTE STREET, NEW YORK

ROBERT B. LUCHARS, President EDGAR A. BECKER, Vice-pres. and Treasurer ERIK OBERG, Editor FRANKLIN D. JONES, Associate Editor
CHARLES O. HERB, FREEMAN C. DUSTON and JOSEPH E. FENNO, Assistant Editors
LONDON: 52-54 High Holborn PARIS: 15 Rue Bleue

YEARLY SUBSCRIPTION: United States and Canada, $3 (two years, $5); foreign countries, $6. Single copies, 35 cents.

Changes in address must be received by the fifteenth of the month to be effective for the forthcoming issue. Send old as well as new address.

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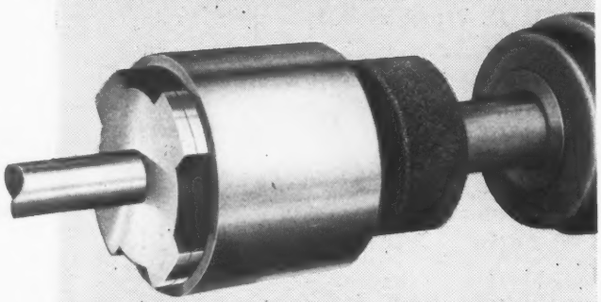

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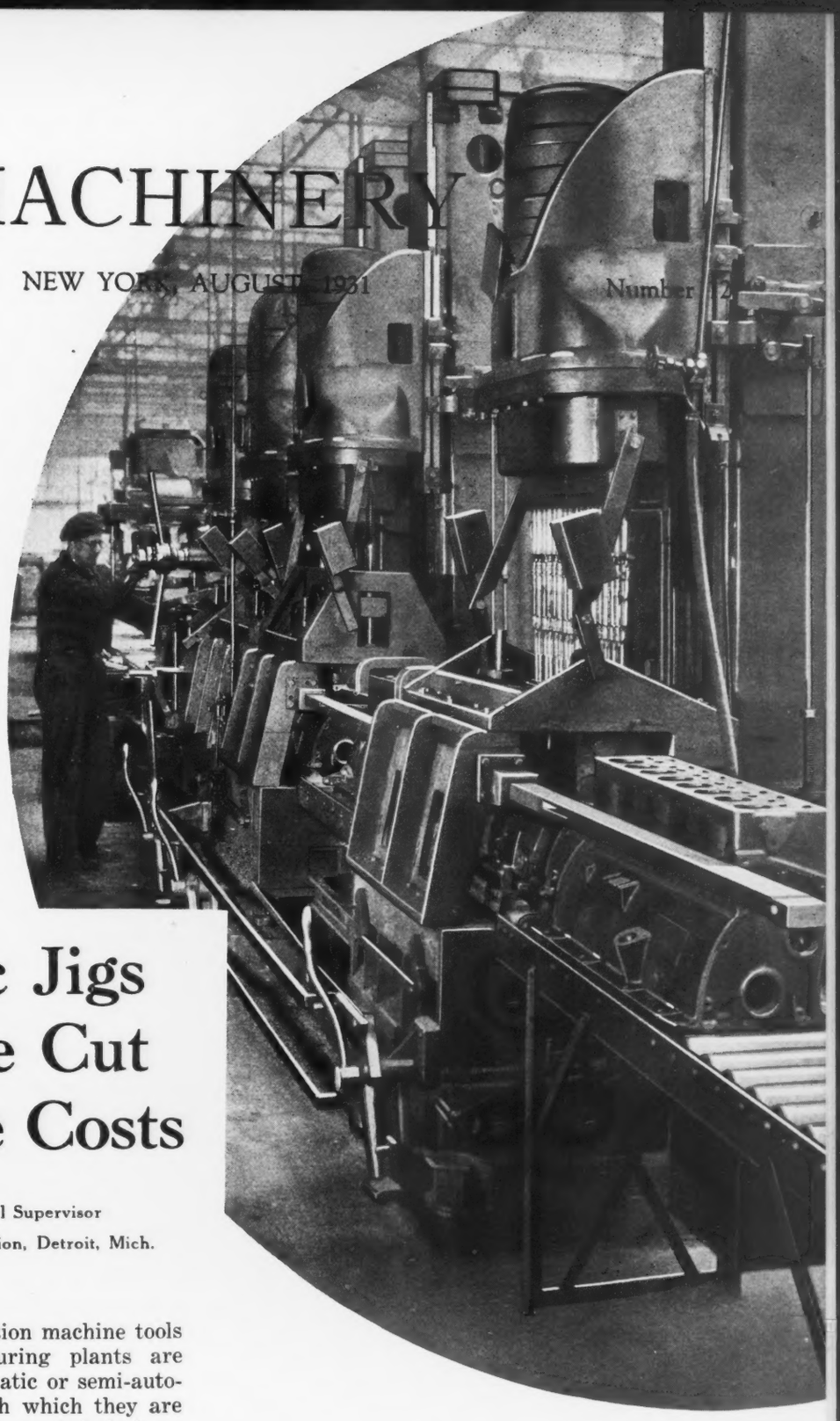
Volume 37 NEW YORK, AUGUST, 1931 Number 2



Jigs and Fixtures that Automatically Locate and Clamp the Work Save Labor and Loading Time

Automatic Jigs That Have Cut Automobile Costs

By JOSEPH P. LANNEN, Tool Supervisor
The Graham-Paige Motors Corporation, Detroit, Mich.

ALTHOUGH the high-production machine tools in automobile manufacturing plants are usually either fully automatic or semi-automatic, the jigs and fixtures with which they are equipped are generally of hand-operated designs. After the operator has loaded the work, he must move levers or tighten nuts here and there to actuate locating dowels and clamps.

Realizing that a vast amount of energy and time could be saved if the work were located and clamped automatically, the tool design department of the Graham-Paige Motors Corporation, Detroit, Mich., set about to apply automatic jigs and fixtures wherever possible in the cylinder department. These jigs automatically locate and clamp the work, and when the operation is over, the clamps automatically release. One fixture even turns over to remove chips from the cylinder, ready for the next operation.

The heading illustration shows a battery of four vertical multiple-spindle machines in the cylinder line. Three of these machines are equipped with automatic locating and clamping jigs. In addition, the four machines, as well as the dumping table between the third and fourth machines, are unloaded simultaneously by the movement of a single

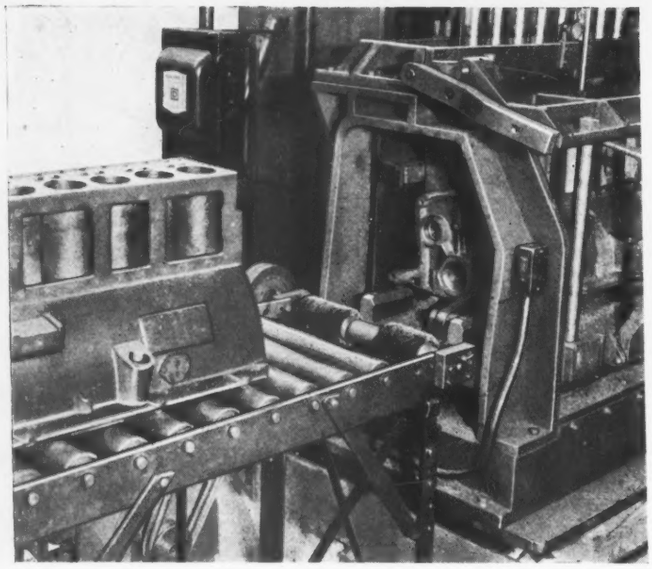
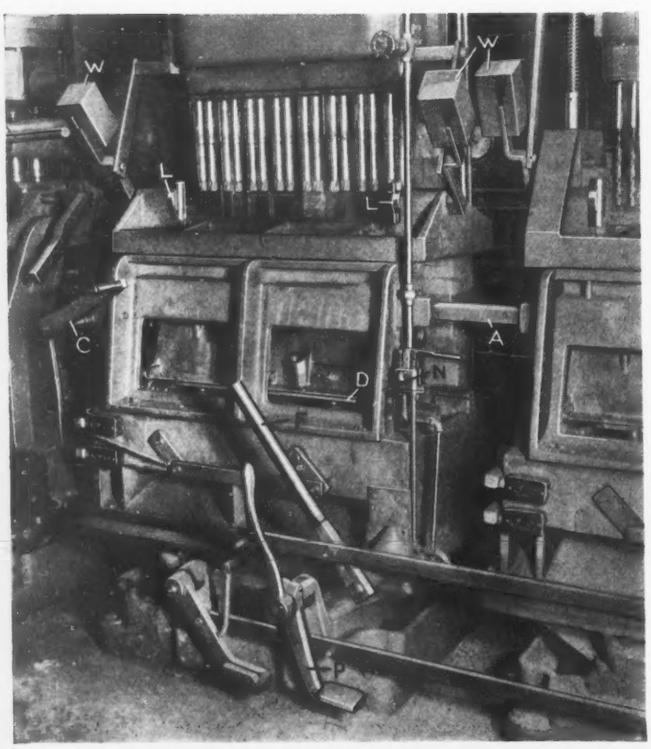


Fig. 1. Wire Brushes Facilitate Locating of Cylinder Blocks by Removing Oil and Grease Left from a Previous Operation

Fig. 2. Operator's Station from which Three Machines and a Dumping Table are Loaded Simultaneously with Cylinder Blocks



lever. As the operator completes the movement of this lever, the tilting table and all the machines, with the exception of the first, are loaded simultaneously with new cylinder blocks. Since the reloading requires only a small amount of time, the operator is able to run two additional machines.

The dumping table removes all chips from the valve guide holes prior to the final operation on these holes, which is performed by the machine in the immediate foreground. The first machine of the group spot-faces the surface around the valve holes accurately to height as determined by means of a dial indicator attached to the drill head. The second machine rough-bores the sixteen valve throats at one time. The third machine drills the valve guide holes, and the fourth machine reams the throats and guide holes.

The cylinder blocks are pushed into the first machine of the group from the conveyor seen in Fig. 1. As the cylinder enters the jig, its bottom surfaces pass over two rapidly revolving wire brushes, which thoroughly remove all the oil and grease left from a preceding tapping operation. Previously, the oil and grease interfered with convenient locating of the work in the jig. These wire brushes are driven by a small motor on the floor adjacent to the conveyor. They revolve in the opposite direction to that in which the cylinder is pushed.

How the Cylinders are Loaded Simultaneously

Simultaneous loading of the second, third, and fourth machines and the dumping table is effected by means of a bar *A*, Figs. 2, 3, and 5, which extends the length of the installation, sliding through bearings in the different jigs. This bar is fitted with a number of spring-actuated fingers *B*, Figs. 3 and 5, which fold in when they meet obstructions during the travel of the bar toward the left, and spring out as soon as the obstruction has been passed.

Thus, when all the operations have been performed by this group of machines and the dumping table, the operator turns crank-handle *C*, Fig. 2, and draws bar *A* to the left a distance somewhat greater than the length of the cylinder blocks. As the fingers *B* on bar *A* pass the cylinders, they fold in, and when they reach the ends of the different cylinder blocks, they spring outward again. The operator then turns crank *C* in the reverse direction, thus moving bar *A*, and with it all the cylinders in the four machines and on the dumping table, toward the right. In this manner, five cylinder blocks are advanced simultaneously to the next operation.

Methods Used in Locating the Cylinders Automatically in the Jigs

The cylinder blocks are located and clamped manually in the jig of the first machine, but these functions are performed automatically in the remaining machines. As the cylinder blocks enter the jigs of the latter machines, they are roughly located lengthwise by the spring-actuated fingers on

sliding bar *A*. Flat bars running the length of the jigs locate the castings roughly from front to back. In the second and third machines, the cylinder blocks are held above accurate seating blocks by flat bars such as seen at *D*, Fig. 2, which are provided at both the front and back of the jig. In the fourth machine, transverse flat bars *E*, Fig. 7, hold the casting above the accurate seating surfaces.

When the operator removes his hand from crank *C*, Fig. 2, he immediately places it on the lever *F* and moves it to the right. This causes the second, third, and fourth machines and the dumping table to start their operating cycles simultaneously. As each drill head comes down, the flat bars *D*, Fig. 2, and *E*, Fig. 7, on which the cylinders have been resting are lowered to permit the cylinders to seat themselves on hardened and ground blocks and to enable dowel-pins, such as seen at *G*, Fig. 7, to enter previously reamed holes in the cylinder castings.

Lowering of bars *D*, Fig. 2, and *E*, Fig. 7, is accomplished by releasing a weight at the back of each machine, such as shown at *H*, Fig. 7. This weight is held on a lever connected by a wire rope to the drill head of the machine. The other end of the weighted lever is mounted on an eccentric shaft *J* which extends to the front of the jig. This shaft is connected through links to a second similar shaft *K* at the opposite end of the jig. When weight *H* is released, these shafts are forced to make a partial revolution to permit lowering the studs to which flat bars *E*, Fig. 7, and *D*, Fig. 2, are attached. As this happens, the cylinder blocks seat themselves over the dowel-pins.

Weights Also Produce the Automatic Clamping Action

The clamping of the cylinder blocks in the jigs takes place automatically as weights *W*, Figs. 2 and 5, are released upon the rapid downward movement of the drill heads. These weights are mounted on levers attached to the drill heads through links. The weighted levers actuate shafts having eccentric ends, as seen at *L*, Fig. 2, which engage slots cut across the vertical shanks of flat clamps. When the weights are released, they cause the eccentric shafts to swivel and the clamps are forced down on top of the cylinder blocks to hold them securely for the operation. Each weight is approximately 30 pounds.

The clamps are lifted from the cylinder blocks automatically as the drill heads return to the upper position and raise the weighted levers. Similarly, the cylinders are lifted from the dowel-pins and accurate seating blocks as the weight at the rear of each jig is raised.

One of the Jigs is Designed to Shift the Cylinder Blocks Transversely

The fourth machine of this group requires a movement of the cylinder blocks from front to back, in order to bring the valve throat and guide holes

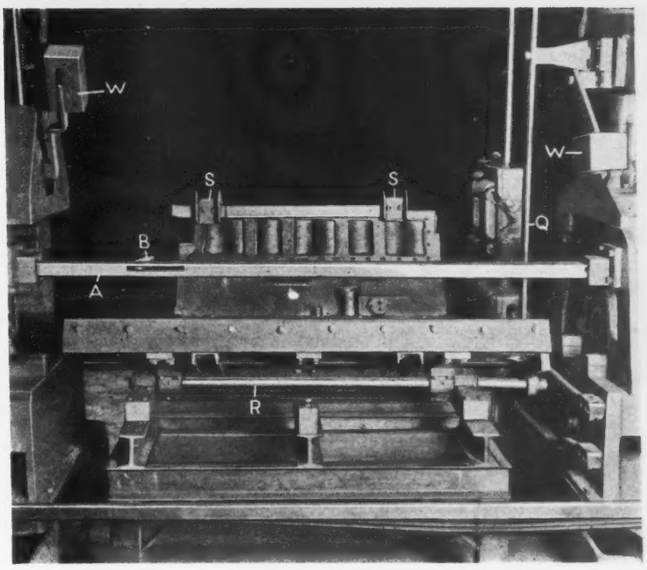
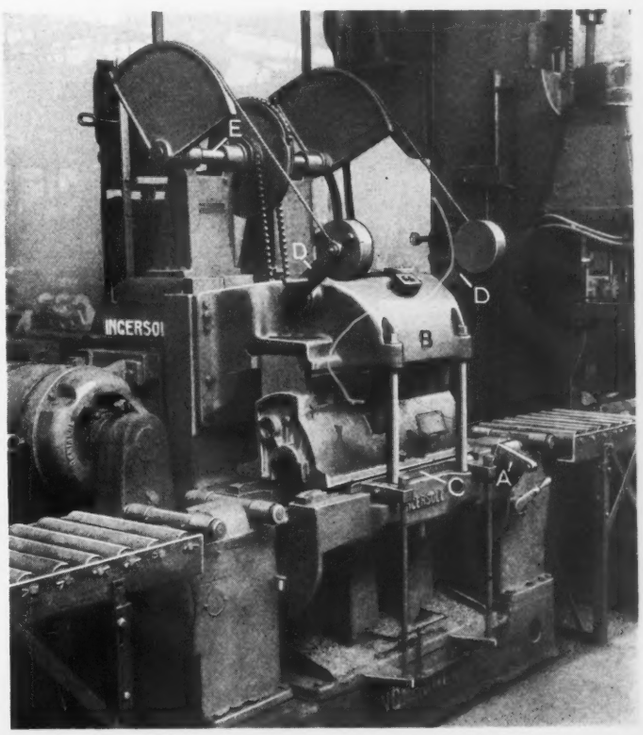


Fig. 3. Dumping Table which Automatically Pours All Chips out of the Valve Guide Holes and Throats in Cylinder Blocks

Fig. 4. Milling Operation in which the Cylinder is Automatically Located and Clamped as the Machine Table Feeds Downward



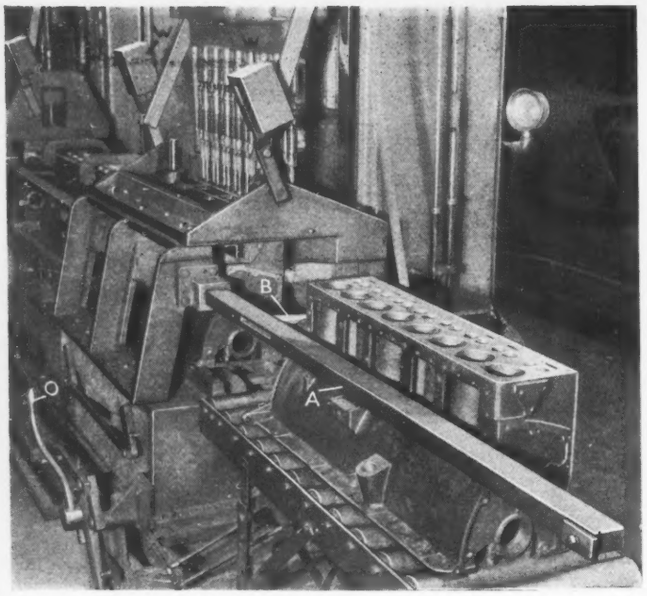
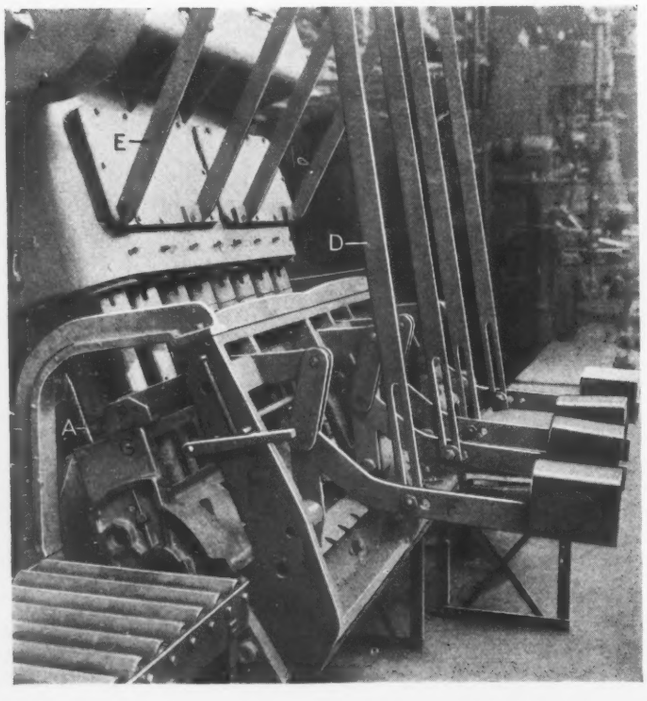


Fig. 5. The Cylinder Blocks are Automatically Loaded and Unloaded by Means of a Long Bar with Spring Fingers

Fig. 6. Four Equalizing Clamps Grip Two Cylinder Blocks as the Table of the Machine Tilts the Work into Line with the Boring-bars



over the pilot bushings that guide the reamers. At the end of the operation, the cylinder block is shifted in the reverse direction for unloading. These transverse movements are obtained by means of two swinging arms *M*, Fig. 7, which are mounted on a shaft actuated by an air cylinder. The air cylinder is controlled by a valve *N*, Fig. 2, at the right-hand end of the second machine. Rack teeth on the air piston-rod engage a pinion on the same shaft as the arms and cause a partial revolution of arms *M*.

In addition to handle *F* which starts the second, third and fourth machines, there is a handle *O*, Fig. 5, that starts the fourth machine. All the machines can be stopped during operation by depressing lever *P*, Fig. 2, and they can also be stopped individually by means of handle *O*, Fig. 5.

Operation of the Dumping Table

Fig. 3 shows the dumping table partially raised from the position it occupies as the cylinder is loaded on it. When the table has been completely dumped, all the valve holes in the cylinder block are pointed downward, the casting being actually turned through about 90 degrees. This allows all chips to slide out of the holes freely. When the table falls into the dumped position, it strikes a wood buffer fitted with rubber pads to deaden the noise.

The tilting of the table is actuated by the drill head of the fourth machine, to which it is attached by rod *Q*. When the drill head travels downward, this rod causes shaft *R* to turn in its bearings and tip over the table. Structural arms *S*, which are fastened to the back of the table, hold the cylinder block to it. The table is fitted with conveyor rollers to facilitate loading and unloading.

Automatic Clamping and Locating in Combination with a Feeding Table

All the crankshaft bearings in the cylinder block are milled simultaneously on the ends by the machine shown in Fig. 4. This machine is equipped with ten cutters mounted on a spindle that extends through the table and into the bearings of uprights at both ends of the machine. The operation is performed by feeding the table downward to bring the cylinder block to the cutters.

When the cylinder block is pushed into this machine, lever *A* is thrown toward the back so as to locate the block roughly in a lengthwise position. The approximate sidewise location is obtained as the block is slid between ways in head *B*. With the table in the loading position as shown, the cylinder block rests on two bars *C* at the front and back of the machine, which hold it above accurate seating blocks and dowel-pins. When the table and head *B* feed downward for the operation, bars *C* tilt downward, allowing the cylinder to seat itself on the hardened and ground blocks and the dowel-pins to enter reamed holes in the casting.

At the same time weighted levers *D* are released, permitting eccentric shafts to swivel and force

large flat clamps down on top of the block in the manner illustrated in Fig. 2. Upon the completion of this operation, the weighted levers *D*, Fig. 4, are pulled upward as shaft *E* revolves, thus releasing the two clamps, and bars *C* are again forced upward to raise the cylinder block from the locating dowels and seating blocks.

A Tilting Machine Table Presented a Different Design Problem

Four cylinders are bored simultaneously in each of two blocks by the machine shown in Figs. 6 and 8. Owing to the fact that the boring spindles of this machine are at an angle, and that the table of the machine tilts to bring the cylinder blocks in line with the boring spindles, it was necessary to provide the jig with a clamping means entirely different from those so far described. As will be seen from Fig. 8, the table of the machine is fitted with conveyor rollers. It is held horizontally for loading and unloading by means of cable *A*. Braces, as shown at *B*, locate the cylinder blocks roughly from front to back and prevent them from sliding off when the table is tilted. Handle *C* moves to bring stops into position for locating the blocks lengthwise.

When the head of the machine feeds downward, and the table tilts, the cylinder blocks automatically seat themselves on hardened and ground surfaces and dowel-pins enter reamed holes in the castings to locate them accurately. Simultaneously, links *D*, which are hinged to the upper ends of braces *E*, move downward and allow the weighted levers *F* to fall. The movement of these levers results in four equalizing clamps *G* being gripped firmly on top of the cylinder blocks. After an operation, when the boring head returns upward, links *D* lift levers *F* and release the clamps.

Jig that Clamps from the Bottom

Fig. 9 shows a simple clamping means which has been applied to a jig used in a multiple drilling operation. As the cylinder block is pushed into the jig from the left, it is located roughly sidewise by angle-irons *A*. Rough lengthwise location is obtained by means of a simple over-running latch, which is raised by hand.

Accurate location of the work both sidewise and lengthwise is effected automatically when the drill head of the machine feeds down. At that time, weights mounted on levers attached to the back ends of shafts *B* cause the shafts to swivel and bring up a large-diameter section at the middle of the shafts. These large sections of the shafts lift the cylinder blocks firmly against hardened and ground blocks attached to the top plate of the jig. Just before the clamping action occurs, dowel-pins enter reamed holes in the cylinder block, such as seen at *C*, to insure accurate positioning of the work. The weight that moves the right-hand shaft *B* may be seen at *D*.

Upon the upward movement of the drill head, wire cables attached to the weighted levers and to

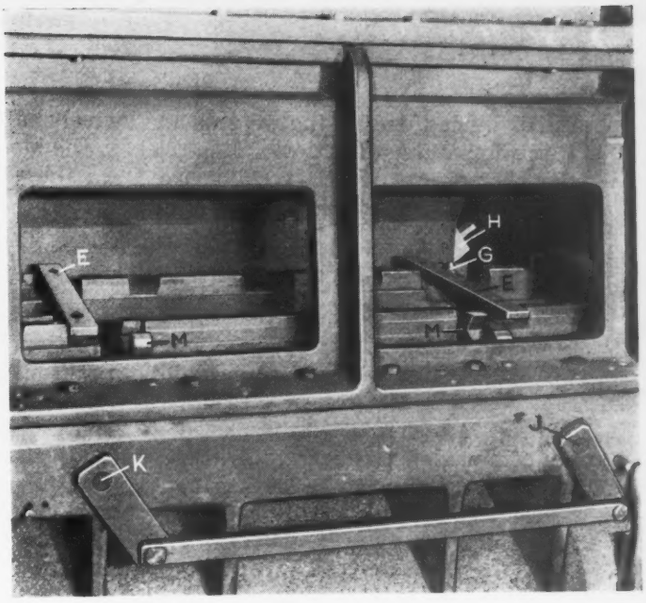
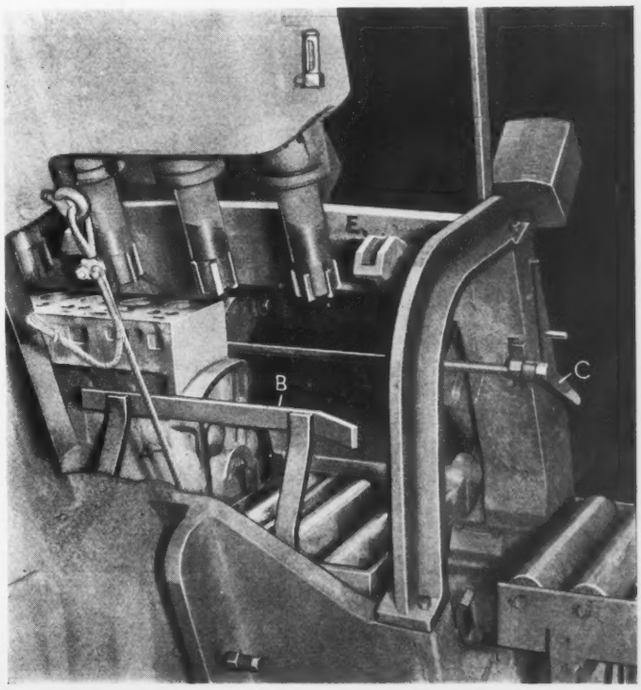


Fig. 7. Jig Equipment that Enables the Cylinder to be Located Accurately on Dowel-pins and Blocks

Fig. 8. View Showing Raised or Loading Position of the Tilting Table Used on the Cylinder Boring Machine Illustrated in Fig. 6



the drill head pull up the weights and swivel shafts *B* in the reverse direction. This releases the block for unloading. When it is pushed from the jig, brushes remove the chips.

Jig that Automatically Raises, Locates, and Clamps Cylinder Heads

An unusual jig employed in drilling cylinder heads is shown in the open or loading position in Fig. 10 and in the closed or drilling position in Fig. 11. From the first of these illustrations, it will be seen that the casting is placed in the jig with the combustion chambers upward. Two adjusting screws *A* roughly locate the casting lengthwise, and it is approximately positioned sidewise by means of two spring plungers *B*.

As the table moves toward the drills, the slack developed in the cable *C* at each end of the jig permits weights *D* to drop down and swivel arms *E* from the position shown in Fig. 10 into the position seen in Fig. 11. Weight *F*, Fig. 10, falls forward at the same time and, through an eccentric shaft that engages shank *G*, closes two fingers *H* on the rib between the two central combustion chambers. In this way, the cylinder head is located for the job.

Weights *J* also drop forward as arms *E* reach the vertical position and close pins *L* over the ends of arms *E*, as shown in Fig. 11, so as to securely lock the arms upright.

When the table of the machine moves away from the drills at the end of the operation, the different weights are returned to the positions shown in Fig. 10, and the various moving parts of the jig operate in the reverse manner to that described.

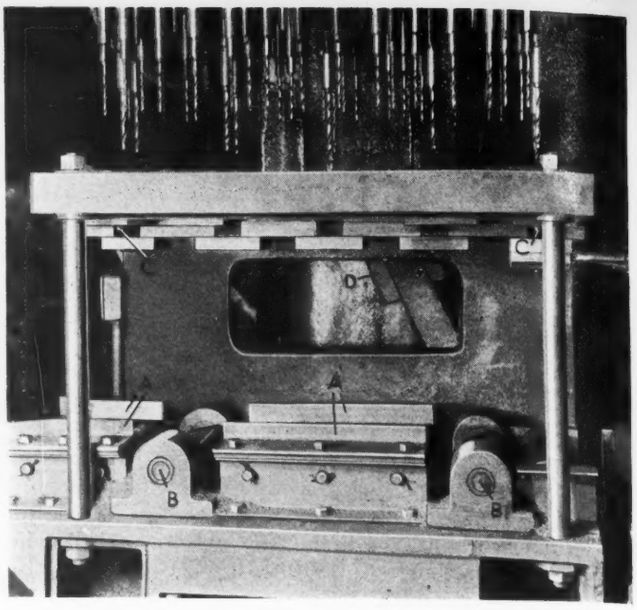


Fig. 9. Large-diameter Shafts with a Flat Surface are Used to Clamp the Cylinder Blocks in This Jig

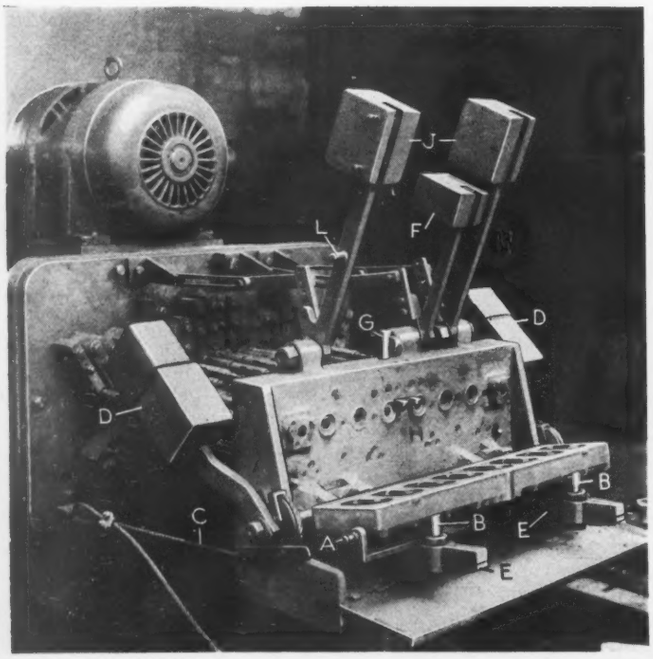


Fig. 10. Jig Equipped with Five Weights that Automatically Locate and Lock the Cylinder Head for Drilling

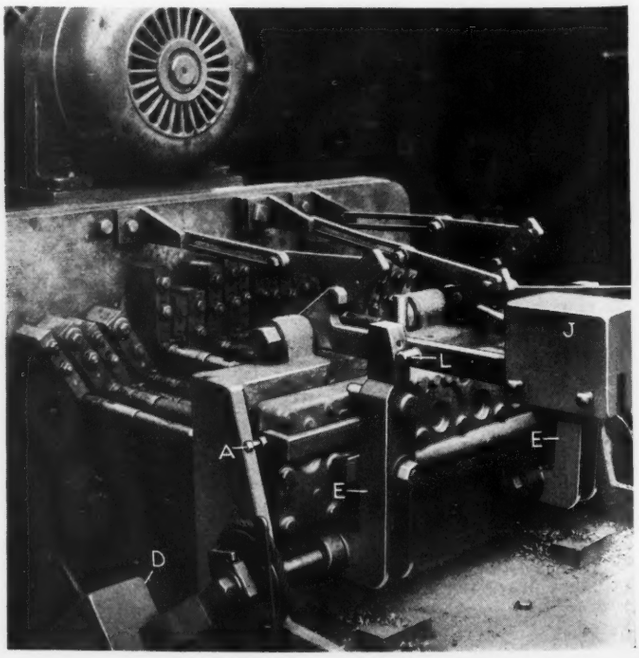


Fig. 11. Cylinder Head Jig, Illustrated in Fig. 10, Shown Locked in the Upright or Drilling Position

The Bidder is Entitled to Some Consideration

A Plea for Higher Standards in Trade Practices and a New Idea of Business Courtesy Toward the Bidder

By RAYMOND H. DAUTERICH
Superintendent, Crescent Engineering Co.
Baltimore, Md.

IF the annual cost of preparing estimates and proposals could be computed, it would reach an astounding figure. This item adds materially to the cost of doing business and must be absorbed in the ultimate cost of the product. Each time bids are submitted by several concerns, only one, of course, is successful in obtaining the order. The expense incurred by the other bidders must, nevertheless, be absorbed in the general course of their business.

When a company asks for bids from five or six competitors on building a machine (or even on supplying a dozen small screws), a definite obligation is incurred toward those who have made bids but do not obtain the contract. This obligation is a matter of ordinary business courtesy. The unsuccessful bidder has spent, perhaps, from $25 to $300 to make a bid. True enough, he did it with the hope of obtaining some business; but he has also furnished to the concern asking for the bid information that it needed in order to be able to determine how to buy most advantageously. In other words, he has helped this concern to save money; and yet, as a rule, if he is not a successful bidder, from the day he drops the bid in the mail box he never hears about it again. Should it not be adopted as a trade custom that unsuccessful bidders be informed that the business has been closed?

How Information Helpful in Running a Business is Obtained Without Paying for It

In some instances, the requests for bids are not even sent out in good faith. The writer has frequently been requested to submit bids intended merely to enable the firm asking for the bid to check up on its own production figures.

Recently blueprints were received from a large company with a request for quotations on the machining of parts and an additional quotation covering assembly work. In checking the drawings, errors were discovered that would prevent the proper functioning of the final assembly. Corrected sketches were made and forwarded to the company, together with a courteous letter asking for the business. The letter pointed out the errors that had been discovered, hoping that the suggestions would prove useful. No answer was received to this letter; but a month later a new set of blueprints arrived, incorporating every suggestion that had been made. A bid was submitted again, but nothing has been heard from this concern since.

It would not be worth while calling attention to this lack of business courtesy if this were an isolated instance; but, unfortunately, cases of this kind are much more numerous than those where the buying concern shows some regard for the bidder.

Another trade practice that should be discouraged is that of asking for a visit from engineering representatives when there is no real business in prospect. There are concerns who do not hesitate to request you to send a representative five hundred miles on a four-day trip, merely to ask to have your drafting-room force furnish a special design for a proposed new single-purpose machine. When you have done your part, you do not even get a reply to your letter and quotation. If you press the concern for a reply, you will learn that they have abandoned the project.

The fact that these practices have been very common in the past, and that almost every machinery builder could furnish examples of such experiences, is no reason why we should continue to use such unethical trade practices. The trouble is that every manufacturer, because of competition, is forced to extend a courtesy to the buyer that the buyer does not show him in return. The seller dares not oppose the unethical practices that are in vogue.

The writer believes that manufacturers' associations should insist that those who ask for bids from a number of manufacturers should, when the contract has been placed, be required to furnish each bidder with a copy of the bids and the name of the successful bidder. What are the objections to such a trade practice, if any?

* * *

Changing Fashions in Reamers

In a paper relating to cutting tools for interchangeable manufacture, read by E. J. Bryant, manager of the gage and reamer departments of the Greenfield Tap & Die Corporation, before the Machine Shop Practice Division meeting of the American Society of Mechanical Engineers at Hartford, Conn., the author pointed out the interesting change that has taken place in reamer design—first, from straight to spiral flutes, then back again to straight flutes, and once more to spiral flutes.

The old straight-fluted reamers were generally superseded by the spiral-fluted type to prevent chatter and to produce smooth holes. Then, with the adoption of staggered spacing, the straight-fluted reamer once more became the vogue, because a straight-fluted reamer will produce a straighter hole than a spiral-fluted reamer. At the present time, probably because of better machine alignment and machining methods, the spiral-fluted reamer has once more come into general use.

Is it Possible Today to Get Boys to Become Apprentices?

By C. J. FREUND, Apprentice Supervisor, The Falk Corporation, Milwaukee, Wis.

MANY employers seem to believe that every young man nowadays wants to do commercial or clerical work—anything that does not involve physical exertion. They say that the young men of today are not made of the stern stuff that prevailed thirty years ago (that is about the time when they were young themselves). They conclude, accordingly, that any attempt to organize an apprentice training course in their plant would prove futile. It should be noted, however, that they are always unable to furnish data to support their contention that young men do not want to learn a trade. This suggests the possibility that they are merely trying to find an excuse for their lack of activity in the field of apprentice training.

It is doubtless true that most young men do not care to go into industry, but this is due as much to the failure of industry to offer them real opportunities as to any aversion on their part to industrial work.

The young men of today are fairly well educated; they are sophisticated, and they expect certain things of the world. They may expect too much, but no one will win them by offering nothing. The time is past, fortunately, when a young man can be expected to be everlastingly grateful for the opportunity to work long hours at small wages with no prospect of promotion.

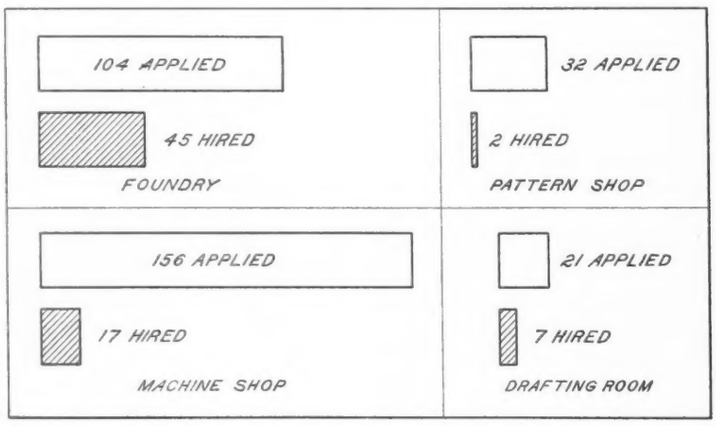
Therefore, the first step in attracting young men to apprentice training is an honest-to-goodness apprentice course, completely organized before the first boy is hired. The organization should include a work program, a supervisory staff, school arrangements, and record-keeping machinery. Enthusiasm of the supervisory personnel in the plant is also essential to the success of the undertaking.

It is the experience of practically all employers who have made such a bona fide attempt to establish an apprenticeship course that more applicants will offer themselves than can possibly be accommodated. For instance, in the plant of the Falk Corporation in Milwaukee, during one year, out of 156 applicants for machinist apprenticeship, 17 were hired; out of 32 applicants for patternmaking apprentices, 2 were hired; and out of 21 applicants for drafting apprentices, 7 were hired.

The number of applicants given in the preceding paragraph does not include all those who actually called at the plant seeking apprenticeship employment, but only those who made a favorable impression. Moreover, many applicants who made a favorable impression were not included in the list, because there appeared to be no opportunity to employ them within a reasonable time. Thus, the number of applicants for pattern shop apprenticeship during the year was more nearly one hundred than thirty-two.

The employer must make the first move. If he does, he will find that there are plenty of fine boys ready to grasp the opportunity to learn a trade.

Relation between Applicants for Apprentice Training and Number Engaged in One Year—Experience of Falk Corporation



* * *

Lubricating Exposed Gears

Outdoor cranes and other machinery in which gears are exposed to the atmosphere can be advantageously lubricated, according to G. H. Olson, manager of the crane and shovel division of the Link-Belt Co., Chicago, Ill., by a mixture made from the following ingredients: 1/2 pound white lead; 1/2 pound flake graphite; and 1/2 gallon cylinder oil.

This mixture adheres well to the gears and can be painted on with a brush at intervals of about five hours. The graphite and oil form the lubricating means, and the white lead acts as a binder. Cup grease can be substituted for the cylinder oil. The graphite may be omitted in cold weather, but it is not advisable to omit it in warm weather. The mixture can be made heavier for warm weather by using less oil or grease in proportion to the quantity of flake graphite.

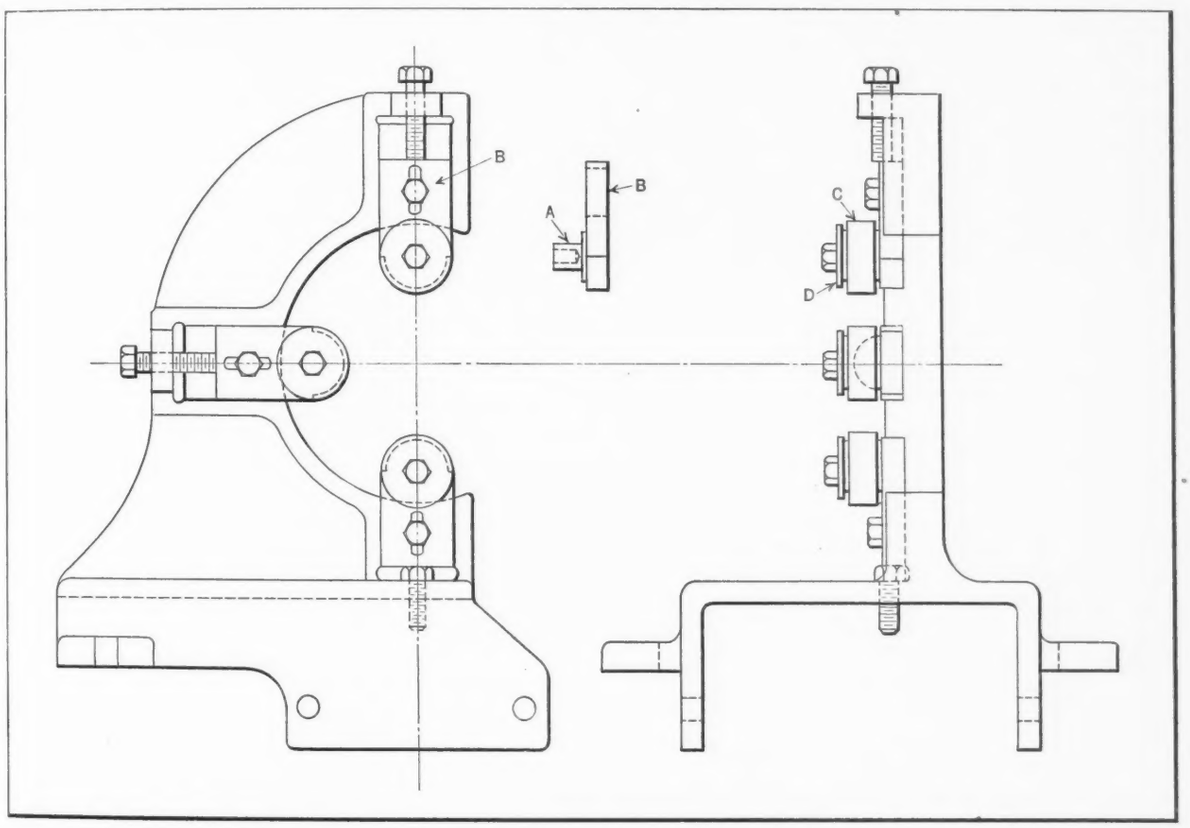
Ball-Bearing Follow-Rest for Engine Lathe

By E. B. GRUENDEL

LATHE follow-rests are usually fastened to the sides of the cross-member of the carriage or just below the cross-slide. As a rule, this position is too far ahead of the tool when feeding the lathe carriage from left to right or too far behind the tool when feeding from right to left. Another criticism of the average follow-rest is that it is not sufficiently rigid. Also, the solid cast-iron jaws generally used are cut up quickly or worn out, and if they are not carefully watched and reset very accurately during a long cut, the work will be tapered and out of round.

A follow-rest made according to the design shown in the accompanying illustration supports the work at a point directly over the center of the cross-slide of the lathe. The cutting tool can be set very easily so that the follow-rest is either directly ahead or directly behind the tool. Increased rigidity is secured by having the follow-rest fastened to the cross-member of the carriage in the usual manner, and in addition having the sides of the base extend over the cross-slide and down to the cross-member of the lathe carriage where they are secured by means of bolts, as indicated in the illustration. The base of the follow-rest is also fastened to the top of the carriage at the rear by two bolts which are fitted in the rear T-slot or the part of the carriage that is directly over the rear way.

The three jaws *C* are of the roller-bearing type, the pin *A* upon which the ball bearing is mounted being solid with the body *B*, which is a close sliding fit in the frame of the follow-rest. This construction is very rigid and eliminates any chance of the pin springing or working loose, which might happen if it were a separate piece. Double-row SKF ball bearings serve as the roller jaws *C*. The outer race of the bearing rolls directly on the work. The bearing is a light push fit on the pin *A*; it is held in place by a cap-screw and the large washer *D*, which completely covers the bearing so that dirt or chips cannot enter the race. The washers, and also the body *B*, are relieved slightly so that the outer races of the bearings are free to turn when the cap-screws are drawn up tight. The ball bearings provide accurate and steady supports for the work, and will stand up well when filled with grease. The ribbed cast-iron frame is sufficiently heavy to provide the necessary rigidity.



Ball-bearing Follow-rest which Supports the Work at a Point Directly Over the Center of the Cross-slide

Multi-Magazine Milling Fixture for High Production

Thirty Tapered Surfaces on Automobile Wedge-bolts are Milled at the Rate of Over 1300 Bolts per Hour

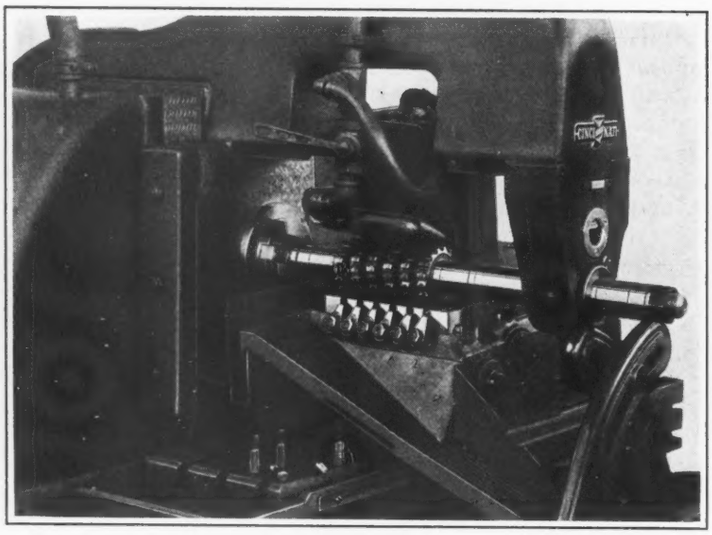


Fig. 1. Magazine Fixture for Simultaneously Milling Six Wedge-bolts like that Shown in Fig. 3

IT is generally true of milling operations that as the size of the part or the amount of metal to be removed decreases, the ratio of the handling time to the total production time increases. This becomes a serious problem on small parts. They must be milled in very large quantities; otherwise, the cost tends to rise out of all proportion to the importance of the job.

The wedge-bolt shown in Fig. 3 is a typical example of this class of work. This part is required in unusually large quantities, as it is used in a popular low-priced automobile. The five tapered surfaces must be milled within very close limits. This high degree of accuracy increases the handling difficulties.

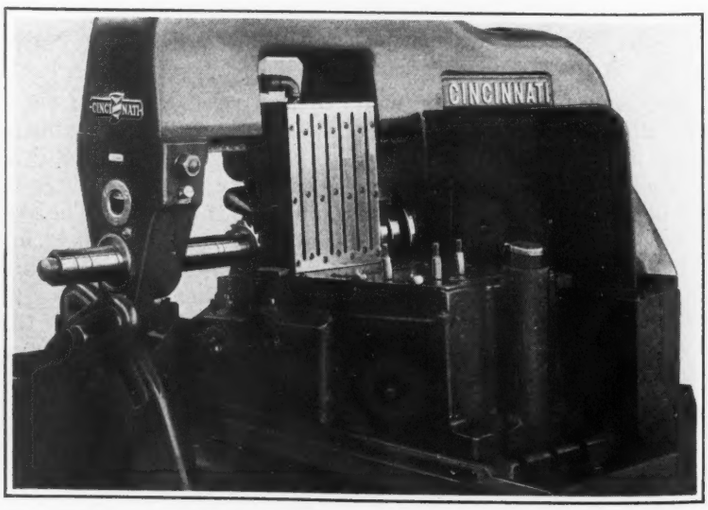
The problem was worked out by using an automatic magazine fixture in conjunction with a Cincinnati Hydromatic miller, as shown in Figs. 1 and 2. The production obtained with this equipment exceeds 1300 pieces per hour, and only one pass of the cutters is required to mill six pieces.

The parts are fed into position for milling by a battery of six magazines. The operator merely keeps the magazines filled; the rest of the operation is entirely automatic. The magazines are fool-proof, being designed so that the pieces can be loaded only in one position and parallel to each other. There is no possibility of getting the work into the fixture in the wrong position.

The feeding action is shown diagrammatically in Fig. 4. After the machine table, the cycle of which is continuous and automatically controlled by dogs, has carried the fixture away from the cutters, the shuttles *A* rise to the position indicated by the dot-and-dash lines. In the meantime, the clamps *B* are released and swung around to clear the completed pieces as they are being ejected. Plungers *C* then advance, pushing the six bottom pieces from the magazines into the milling position. This movement, in turn, ejects the six previously finished pieces. The shuttles now drop down to form the back stops against which the work is held, and the clamps *B* swing back into position against the front of the work pieces. Next, the table reverses, and is returned to the feeding position by the quick traverse, after which the parts are milled.

As shown in Fig. 1, the pieces, when in the milling position, rest in closely fitted pockets which prevent side movement. These pockets are sloped to correspond with the angular surfaces to be milled, and slotted at the top to allow the milling cutters to enter. The machine is provided with a gooseneck rectangular over-arm. This arrangement allows the magazines to be set very close to the cutters without interference.

Fig. 2. Front View of the Fixture Illustrated in Fig. 1, Showing the Magazine Arrangement



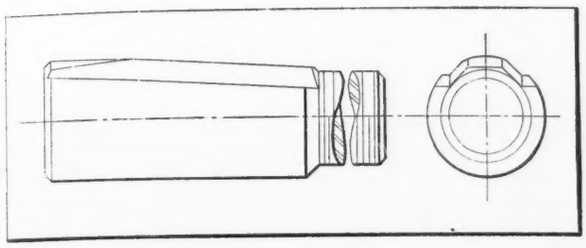


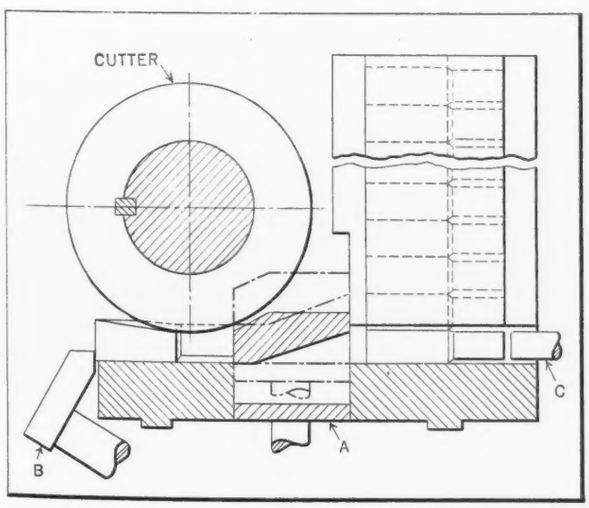
Fig. 3. Automobile Wedge-bolt Milled on a Production Basis in a Magazine Fixture

Because of the compact arrangement of this fixture and the large amount of chips produced, there is a possibility of work jamming. However, with a hydraulic feed, such as that with which the machine is equipped, if jamming occurs, the pressure in the hydraulic system will be built up almost instantly and a relief valve will be opened, thus protecting the mechanism. In such a case, the operator merely backs the table out, cleans the fixture, and is ready to go on again. To aid in chip disposal, a heavy flood of coolant is poured on the work and the bottom of the work-holding pockets is slotted to allow the coolant to carry off the chips.

* * *

Directly and indirectly, the automobile industry employs 4,700,000 people out of a total of 46,000,000 people gainfully employed in the United States. This means that one out of every ten workers finds employment directly or indirectly in connection with the automotive industry. This includes those engaged in selling automobiles, in servicing them, and in driving them for commercial purposes.

Fig. 4. Diagrammatic View, Showing How Parts are Fed from the Magazine of the Fixture Illustrated in Figs. 1 and 2



Cutting up a 55-Ton Steel Casting with an Oxygen Torch

In rearranging its plant recently, a mid-western company found it necessary to remove and scrap a 55-ton cast-steel block of the dimensions shown in the accompanying illustration. As it was impossible to dispose of this enormous casting as a single piece, an oxy-acetylene service operator was called upon to advise as to the best method for cutting it into pieces of regular charging box size, namely, 18 by 28 by 60 inches. On checking over the proposed lay-out for the cuts, it was found that the amount of work could be reduced considerably by cutting the casting into pieces 20 by 20 by 46 inches.

The lay-outs for the cuts on the top, side, and end of the casting are shown by the cross-section lines

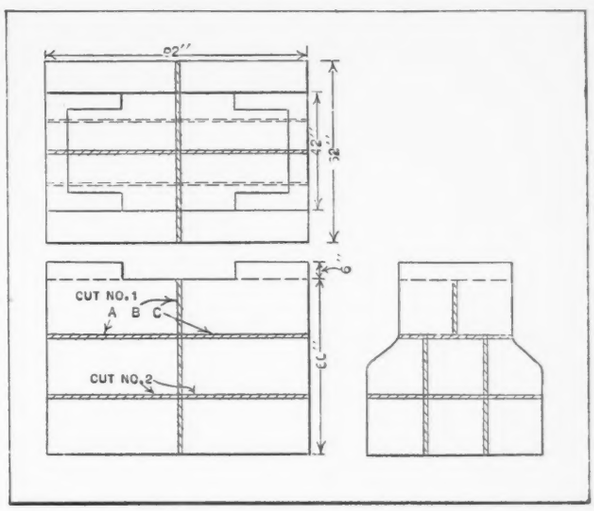


Diagram Showing How a Steel Casting was Cut up into Scrap with an Oxy-acetylene Torch

in the illustration. Cut No. 1 was made through the casting at *A*, then at *B* and *C*, the thickness at this point being 42 inches. Cut No. 2, through the lower section, was made after the piece had been raised to provide for the removal of slag. The thickness of the metal at this point was 62 inches. After completing these cuts, the remainder of the cutting was through material having a thickness of only 20 inches. On the two extremely heavy cuts, the cutting torch alone was used. On the lighter cuts, such as the one at the top of the casting, blowpipes were used in combination with the lance in order to speed up the work.

* * *

For ordinary use, pin punches made of the same grade of steel as that used for cold chisels are usually satisfactory, but when a punch of extra length is required, a piece of spring steel, properly hardened, will give better service.

Should Foremen be Selected For Their Skill as Workmen?

An Appraisal of the Characteristics of Over 1700 Foremen Made by Themselves Indicates that Technical Skill is not the Most Important Qualification

By ROY D. BUNDY, Industrial Coordinator
Board of Education, Cleveland, Ohio

MEN may be divided into three general classes with respect to their mental characteristics: (1) Those having a strong tendency toward action and leadership; (2) those having the capacity to deal best with things; (3) those having the capacity to deal effectively with abstractions.

There is no sharp dividing line between these classes. They overlap, and in many persons all three characteristics may be present. These characteristics are believed to be largely the result of environment.

When a foreman is selected for a job, therefore, careful consideration should be given not only to his natural abilities and background, but also to the environment in which he is expected to function. The president of a large industry recently made the statement that he knew exactly what his executives were thinking, because he put all the ideas they had into their heads. This, he said, was necessary because they had none of their own. He also voiced the regret that initiative and loyalty were at a low ebb in his executives. What natural abilities and background should a foreman or a department head have in order to fit successfully into the environment described by this president? Would they be the same as would be required in another plant whose president said: "We have specialists to do our purchasing; we have specialists to employ the best workmen; then we turn all this material, human and concrete, over to the foreman to use; he is the man who holds our pocketbook; he should be the best man it is possible to obtain, and we must throw around him an environment that will bring forth the greatest possibilities in his development."

It requires no stretch of the imagination to picture the type of department head that will be found in each of these organizations. In the one will be found the typical "yes" man; in the other, foremen with enthusiasm and desire for success, alert, and eager to "go the limit" for "the old man." They are simply measuring up to the confidence that has been placed in them.

How Foremen Rate their Own Problems

General Classification of Problem	The Problem Considered Most Difficult by the Foremen	Number of Foremen Troubled by this Problem	Per Cent of Total
With Men	To get suggestions	22	
	To build a good organization	18	
	To keep men interested	64	
	To select proper man for the job	21	
	To maintain the working force	15	
	To instruct men	627	
	To secure discipline	45	
	To discharge men	8	
	To put premium system into effect	6	
	To secure cooperation with other foremen	106	
	To sell safety to the men	24	
	To make supervision effective	6	
	To secure production and quality	57	
		1019	56.7
With Self	To keep up with the times	38	
	To develop leadership	49	
	To work out new ideas	16	
	To use self-control when something happens	43	
	To be diplomatic	22	
	To distribute your time properly	50	
	To practice what you preach	13	
	To arrive at a just decision	19	
	To plan ahead	80	
	To get to work on time	16	
	To interpret the company's policy to workmen	27	
		373	20.8
With Things	To reduce scrap	25	
	To keep supplied with stock	90	
	To salvage parts	9	
	To keep things in order	72	
	To keep machines in working condition	9	
	To set piece-work standards	25	
		230	12.8
With Superior	To sell ideas to a superior	70	
	To get proper tools and equipment	10	
	To get enough help	15	
	To manage the boss	23	
	To follow instructions	8	
	To feel at ease in the presence of a superior	47	
		173	9.7

But does not the method of handling depend upon the men? Not nearly so much as upon the man who is doing the handling. He is the one who controls the environment under which his foremen work.

On the other hand, a foreman should be able to adjust himself to his environment. This may prove difficult, especially if there is a radical change in his surroundings. It is important for everyone to be able to become part of his environment. Few can expect success if they require a specially created environment for their happiness. But men who have one or more of the three capacities outlined in the first paragraph of this article are likely not only to make the necessary adjustments themselves, but also to cause the environment to make some adjustments.

Many foremen have been selected because they have a capacity for dealing with things. They have proved themselves to be the best workmen in a department. This is an important consideration, but it is possible for the best workman to be a very poor foreman. Those responsibilities of the foreman's job that he is best fitted to assume will be the easiest part of his work. Likewise, the most difficult part will be that on which he is least experienced. It is, therefore, of importance to recognize what phases of foremanship are considered the most difficult by foremen themselves.

In reply to the question "What is the most difficult part of your job as foreman?" 1795 foremen contributed the replies tabulated in the accompanying table. The exact phrases in these answers have not been used in all cases, because of the necessity of grouping them under general headings. For instance, numerous expressions are grouped under "discipline" such as "to get the men to work on time"; "to get the men to follow instructions"; "to enforce rules"; etc.

Four classifications were made of the difficulties listed as follows: Difficulties involved in handling men; difficulties with self; difficulties with things; difficulties with superiors.

A glance at the table indicates in which group the most difficulties fall. The handling of men is the greatest problem of 57 per cent; difficulties with themselves is the main trouble of 21 per cent. Self-control must come before one can control others; therefore, these 21 per cent are closely tied up with the 57 formerly mentioned. The 21 per cent who realize their own weakness considered the cause instead of the effect. Approximately 10 per cent had the greatest difficulty in dealing with their superiors. This percentage is too large when the importance of complete understanding between superior and subordinate is considered.

Summing up these data, we find that 87 per cent of the foremen considered some phase of human relations as the most difficult part of the job. The largest single item is that of instructing men. This might be expected when we consider that the majority of all foremen have been promoted from the bench. They were skilled craftsmen, but their difficulty lies in not being able to impart their knowledge of the job to another man.

The table indicates that the selection of foremen should be based on a search for men who have a strong tendency toward action and leadership. It is not the purpose of this article to discuss where such men can be found, but it might be suggested that they are reared in an environment that encourages the development of the traits required. This technique of locating the most difficult part of the job furnishes a scientific procedure for the development of a training program—one that will be readily accepted by the foremen when it is effectively presented.

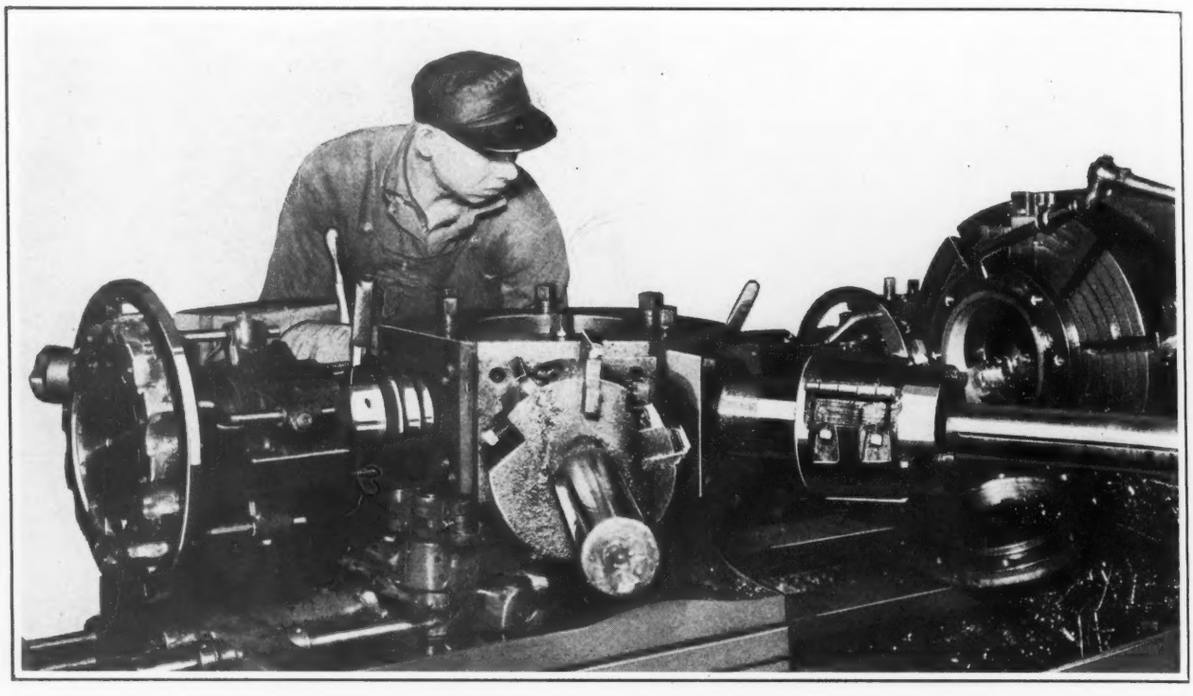
Brake-Drums of Nickel Cast Iron

The use of nickel cast-iron brake-drums has become almost standard on all heavy-duty trucks and buses, according to a paper by Thomas H. Wickenden, of the International Nickel Co., Inc., read before a meeting of the Society of Automotive Engineers at Milwaukee, Wis. Material similar to that used for these brake-drums is also excellent for clutch plates. The mixture for brake-drums must be suitable for the purpose; the presence of excessive amounts of free carbides will result in their wearing unevenly and eventually tearing out the lining. If the cause is not known and the lining simply replaced, it is likely to be torn out again within a few days. A common mixture for brake-drums is one containing 3.20 to 3.40 per cent carbon; 2 to 2.25 per cent silicon; 1.50 per cent nickel; and 0.50 per cent chromium. Material of this analysis is generally made by the addition of nickel and chromium to a cylinder iron.

Drums of this material have a satisfactory life under most conditions. On heavy-duty trucks and on passenger cars, where it is an advantage to save weight and use as thin walls as possible, it is desirable to use what is known as high-test iron. A high-test iron has a strength of from 40,000 to 50,000 pounds per square inch. The silicon content of this iron runs between 1.50 and 1.75 per cent, depending somewhat upon the section. A nickel content of 2 to 2.50 per cent—in some cases with 0.20 to 0.30 per cent chromium—has given satisfactory results on brake-drums of heavy-duty trucks.

* * *

Announcement has been made that Ambrose Swasey, founder of the Engineering Foundation, has added $250,000 to his previous gifts to the Foundation, bringing the total to three-quarters of a million dollars. The purpose of these gifts is to stimulate research and development work in science and engineering.



Which Would You Choose— a Solid or a Collapsible Tap?

By M. A. HOLLENGREEN, Assistant Chief Engineer, Landis Machine Co., Waynesboro, Pa.

COLLAPSIBLE taps offer many advantages over solid taps. The greatest of these is the fact that "backing out" is eliminated—a feature that results in much saving of time. A solid tap dulls more rapidly than the collapsible type because of its rubbing action on the thread as it is removed from the tapped hole, and this often causes torn threads. Collapsible taps also have the advantage of size adjustment, thus enabling more accurate threads to be cut.

There are two types of collapsible taps—the plain and the receding type. The plain type is equipped with short chasers, and can be used for tapping straight threads of various lengths. At the end of the thread the chasers collapse into the tap body, allowing the tap to be withdrawn quickly from the work without reversing the machine and backing the tool out, as is necessary with a solid tap.

An unusual application of a tap of this type is shown in Fig. 1. Here, the tap is mounted in the turret of a lathe and fitted with an extra long body in order to cut a straight internal thread 25 inches long in a length of seamless tubing. In this case, it is obvious that the collapsible feature effects a substantial saving in reducing the time required to withdraw the tap.

The receding type of collapsible tap is used for cutting tapered pipe threads. As

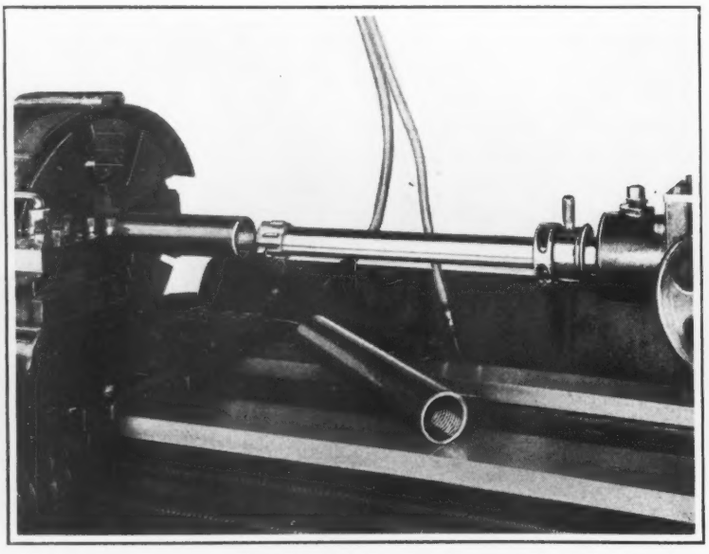


Fig. 1. Cutting a Straight Thread, 25 Inches Long, in a Piece of Seamless Tubing with a Collapsible Tap Provided with an Extra Long Body

in the plain type, this tap also employs short chasers. It is not limited, however, to standard pipe threads, but can be adapted to other work having threads of various diameters, tapers, and lengths.

Difficulties Experienced with Solid Tapered Taps

Before the development of the receding collapsible tap, it was almost impossible to use an ordinary solid pipe tap to cut long tapered threads in tough steel, because the power required to drive the tap was not always available; and even with a machine of sufficient power, the tap would often break before it had reached its full depth. Consequently, it was frequently necessary to resort to the slower but surer method of using a taper attachment for chasing the threads.

How Receding Taps Solved the Difficulty

After a great deal of experiment, it was found that the logical way to produce taper threads was to use short chasers which receded as the tap was fed into the hole. This is not a new principle, as it has been used for a long time in self-opening dieheads employed for cutting tapered external threads. With the collapsible receding taps, all the cutting is done by the first few teeth, as is the case when straight threads are cut with a plain tap. It has been demonstrated in a power test that approximately one-fifth as much power is required to drive a receding tap as a solid tap.

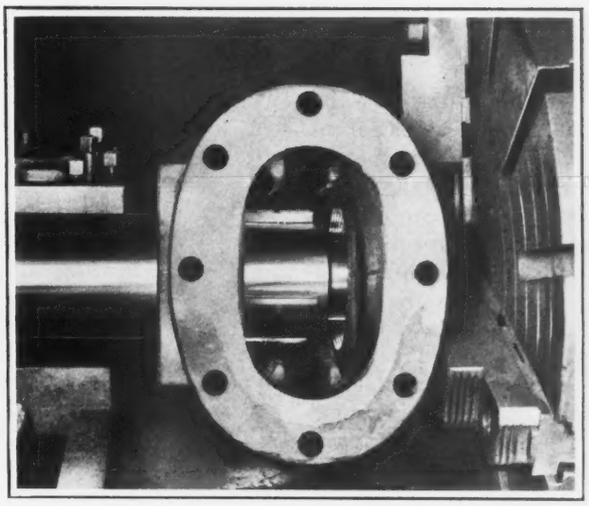
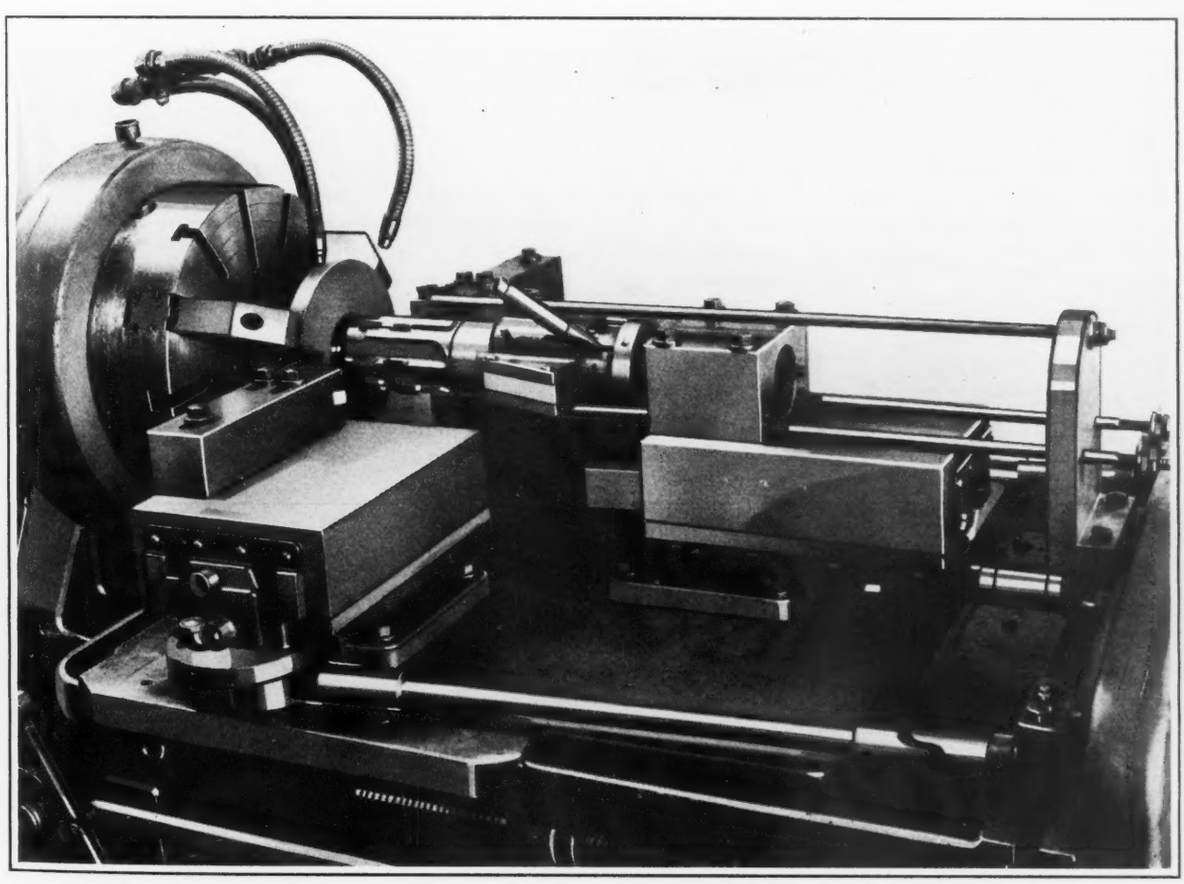


Fig. 2. Collapsible Tap Equipped with Double-end Chasers for Tapping Valve Body Seats, the Diameters of which are Larger than the Pipe Openings

Fig. 3. Set-up for Tapping Pipe Flanges, in which an Expanding Collapsible Tap is Equipped for Boring the Tapered Hole in Advance of the Chasers



The large sizes of receding taps manufactured by the Landis Machine Co. have demountable heads for various thread diameters, and any combination of two tapers can be cut with the same tap, the length of the thread being limited only by the travel of a cam in the tap body. These features result in considerable saving in equipment where threads of various diameters, tapers, and lengths are cut.

Boring and Threading in Inaccessible Places

Machining and tapping the seats of valve bodies—a "blind" operation—frequently causes valve manufacturers considerable trouble, and is one of their most expensive operations. The reason for this is that the thread diameter of the internal seat is usually larger than the pipe ends on the outside of the valve body. Hence, an ordinary tap cannot be used. Previously, this thread was cut by the slow method of using a chasing tool.

Now, however, the work is done with a collapsible tap. In Fig. 2 is shown a close-up of this tool in action. To complete the operation, two taps are used. No threading is done with the first tap, the chasers being replaced with double-end reaming and counterboring cutters. After these cutters have been brought into position inside the valve body, they are expanded by shifting an operating handle. The seat at the right is then counterbored and reamed, after which the turret is drawn back and, without reversing the machine, the seat at the left is similarly machined. The cutters are then collapsed and the tap is withdrawn.

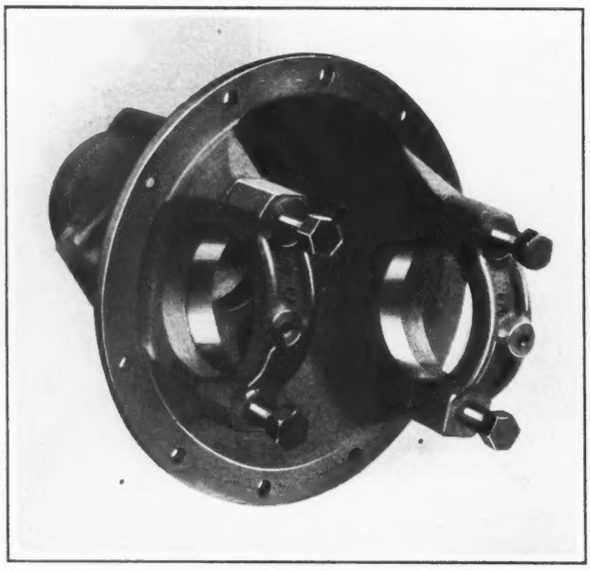


Fig. 4. Differential Housing in which Two Bearing Seats are Bored, Reamed, and Tapped Simultaneously with the Tap Shown in Fig. 5

The second tap is fitted with chasers. It is carried into the body, and the seat at the right-hand side is tapped first. The tap is collapsed at the completion of the thread and removed to the center of the body, where the chasers are again expanded into their tapping position. The machine is now reversed, and the seat at the left is tapped as the turret is drawn toward the left. When this thread is completed, the tap is again collapsed and withdrawn from the valve body, and the job is finished.

The heading illustration shows a receding collapsible tap of the demountable-head type being used to tap steel pipe flanges. When flanges are machined in this manner, it is usually necessary to chuck and face one side of the flange. Following this, the flange is reversed, rechucked, and squared up by its finished face, after which the hole is bored and reamed. During the tapping operation, the chasers are withdrawn into the tap-holder by means of cams, the threading being started at the large end of the bore.

Another method of doing this job with an appreciable saving in time is illustrated in Fig. 3. Here an expanding instead of a receding collapsible tap is used in a Gisholt Simplimatic. By completing the machining operations in one chucking, a flange face perpendicular to the tapped hole is insured. The front slide of the machine roughfaces the flange, and the rear slide finish-

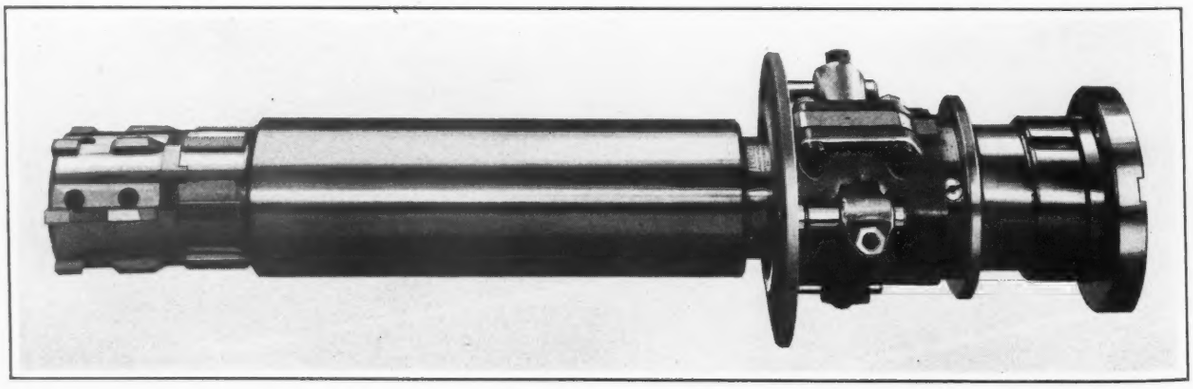


Fig. 5. Collapsible Tap Equipped with Boring and Reaming Cutters, as well as Chasers, for Machining the Bearing Seats in a Differential Housing

faces it. The tap is equipped with a set of cutters for boring a tapered hole, and these cutters expand as they travel through the flange, cutting from the small to the large diameter. The cutters are followed by the expanding chasers, which thread the flange hole in the same manner.

When the thread is completed, the tap automatically collapses and is withdrawn from the work. The time required for this operation is six minutes for a 6-inch flange, and twelve minutes for a 12-inch flange. Incidentally, as the slides are returned to the cutting position, the boring cutters and chasers automatically recede for the next flange.

Special Machines Built for the Use of Collapsible Taps

During recent years the automotive industry has presented an almost unlimited field for the use of collapsible taps. One of the most notable developments along this line has been in the boring, reaming, and tapping of bearing seats in differential housings like the one shown in Fig. 4.

So great has been the advantage offered by the collapsible tap method that special machines have been built around it. One of these machines is used for boring and threading parts like that shown in Fig. 4. It is equipped with two opposite sliding heads which are actuated by a combination lead- and feed-screw. In each head is mounted a collapsible tap such as shown in Fig. 5. Each tap is equipped with cutters and chasers for performing three operations, namely, rough-boring, reaming, and tapping the bearing seats.

As the operation is started, the feed-screw carries the combination taps toward the work at the proper rate to rough-bore and ream the two bearing seats. When the cutters have reached their proper depth, control dogs trip the feed and change the boring feed to the proper rate for threading, at which time the tapping operation begins. When tapping has progressed to the proper depth, the chasers collapse into the body of the tap, following which the sliding heads reverse automatically and return by rapid traverse to their starting position. Another example of a combination collapsible tap used extensively in the automotive field for tapping the tandem bores in differential carriers is shown in Fig. 6. In order to insure exact concentricity, each set of chasers is provided with a pilot.

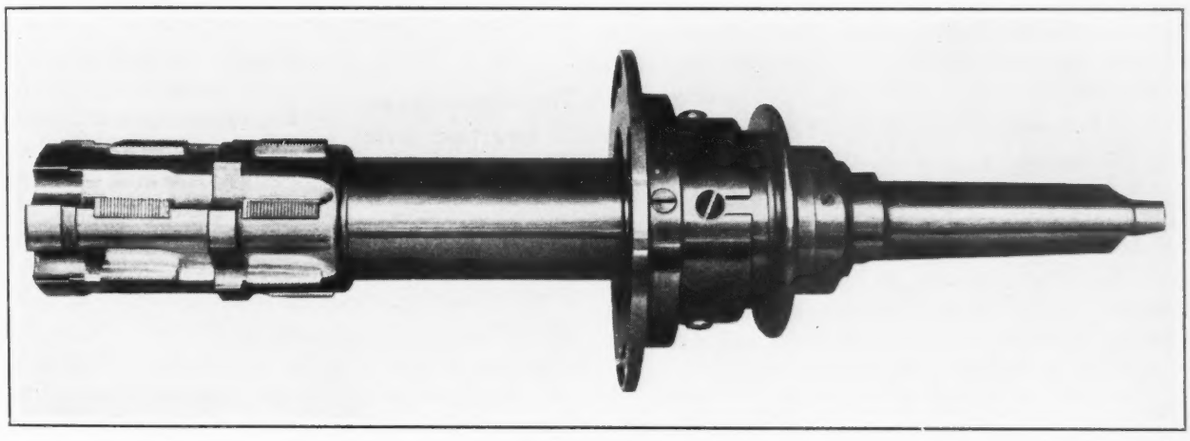


Fig. 6. Collapsible Tap Employed for Threading Tandem Bores in Differential Carriers

* * *

Society for Testing Materials Elects Officers

The American Society for Testing Materials has elected the following officers for the ensuing year: President, Frank O. Clements, technical director, Research Laboratories, General Motors Corporation, Detroit, Mich.; vice-president, Samuel T. Wagner, consulting engineer of the Reading Co., Philadelphia, Pa. Members of the Executive Committee: Arthur W. Carpenter, manager, Testing Laboratories, B. F. Goodrich Co., Akron, Ohio; Kenneth B. Cook, technical manager, Manville Jenckes Co., Pawtucket, R. I.; J. B. Johnson, chief, Material Branch, Material Division, U. S. Army Air Corps, Wright Field, Dayton, Ohio; George C. D. Lenth, consulting engineer, Chicago, Ill., and O. L. Moore, engineer of tests, Universal Atlas Cement Co., Chicago.

* * *

Records of Machine Repairs

In one large automotive plant, the cost department keeps a record for every machine in the shop, which shows when a machine is out of operation because of repairs, and also gives the cost of repairs that have been made on the machine since its installation. This record offers a convenient means of judging the value of different makes of machines, and is a great aid in deciding on the best type to buy when new equipment is required. Sometimes two or more makes of machines may appear to be equally good, but the repair records will show that one of them excels all the others in small maintenance cost.

EDITORIAL COMMENT

In some plants the idea that overhead charges must be kept down has been preached so effectively that possible savings in production costs are sacrificed because one item in the costs—the overhead—is given undue importance.

It is sometimes possible to reduce unit costs of production by increasing overhead. While the installation of new machines and other shop equipment generally increases the overhead charges, the new equipment may make it possible to produce at a lower cost per piece. This does not apply to machinery alone. For example, the employment of a time-study man increases overhead, but in many shops costs have been reduced through his efforts. Again, the installation of shop laboratories increases overhead; yet, costly mistakes and the use of unsuitable materials have often been prevented by such laboratories, and the increase in overhead due to them has been repaid many times over.

Increased Overhead Should Not Always be Frowned Upon

Matters of this kind are not so much decided by judgment or experience as by plain bookkeeping methods. It is comparatively easy to determine when an increase in overhead costs will decrease the cost of doing business.

It is not an easy matter to ascertain accurately the cost of moving castings and other machine parts from one point in the shop to another during the progress of manufacturing. In making comparative cost estimates, however, the ton-foot method generally employed by industrial engineers will prove a great help. The weight of material moved per day, week, or month, is estimated in tons. The average distance in feet that the material must be moved during its progress through the shop is also ascertained. The tonnage figure is multiplied by the length in feet, and the resulting product, expressed in ton-feet, gives a reliable idea of how much moving of materials is actually done in the shop.

Measuring Cost of Moving Materials About the Shop

This method is especially useful in comparing a number of shop lay-outs or work-routing plans. Recently, three different routing methods were compared in this way. In one case, the material movement amounted to 475,000 ton-feet per month; the second plan required 780,000 ton-feet, and the third, 1,110,000 ton-feet. It is obvious that the latter two plans would have to present some decided advantages to be adopted in preference to the plan that required the least amount of moving of materials, and consequently the least expense.

In the handling of materials, as in other industrial work, definite facts and figures are being substituted for mere opinions. The managers of some shops would be amazed to learn of the number of ton-feet of material that is handled in their plants and how much it costs to move the work in progress.

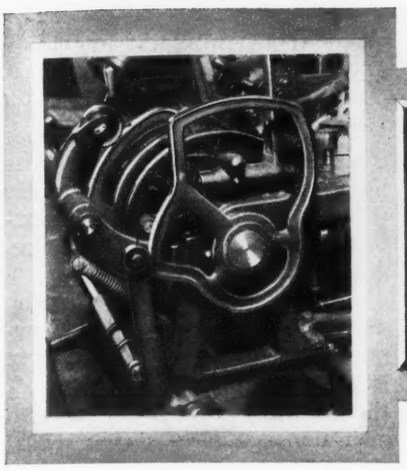
The need for cooperation between the artist and the machine designer has been brought to the fore recently by those engaged in selling machinery and equipment. "More art in machine design" is the slogan. At least one of the large machinery builders has engaged an art director to cooperate with the company's machine designers. As a result, attractive appearance has been given added weight in the design of the products.

The Art Director is Invited Into the Shop

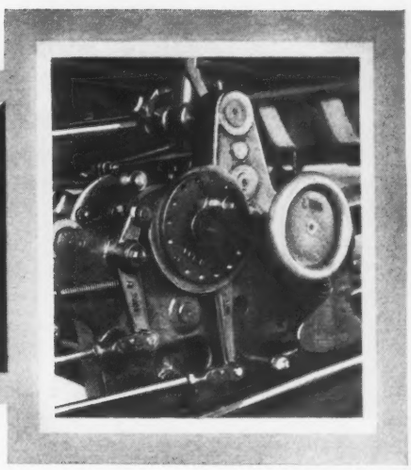
The idea that appearance is important in the design of machine equipment is not new. Ever since machines were first built, there have been designers who have aimed at an artistic appearance, even though they have not always succeeded in creating it. Sometimes their efforts have had exactly the opposite effect. For example, in the middle of the last century upright drilling machines were built with Grecian columns; and stationary steam engines, textile machinery, and machine tools were embellished with castings designed to resemble wood carvings.

Later, it became evident to designers that good appearance could not be secured by extraneous embellishment, but that the most attractive design was that in which every line harmonized with the purpose of the machine. This idea has led to a most remarkable improvement in the appearance of machinery of all kinds—an evolution from crude forms into objects of highly pleasing appearance. Many modern machine tools are excellent examples of this, and so is the modern automobile.

The increasing tendency to pay attention to appearance in the design of machinery and products of all kinds is one of special interest to men responsible for sales. It is no longer true that utility is the buyer's only consideration; in many products it is not even his main consideration. Appearance plays a most important part.



Ingenious Mechanical Movements



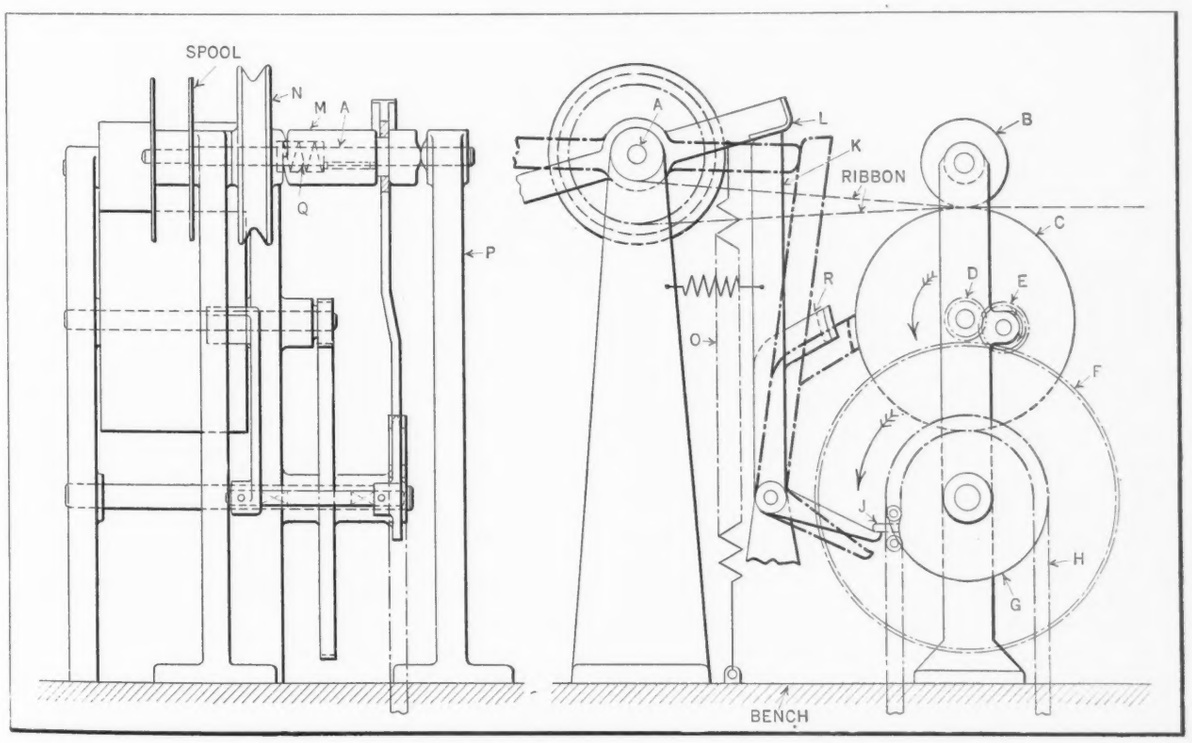
Device for Measuring Typewriter Ribbon as it is Wound on Spool

By EDWARD HELLER

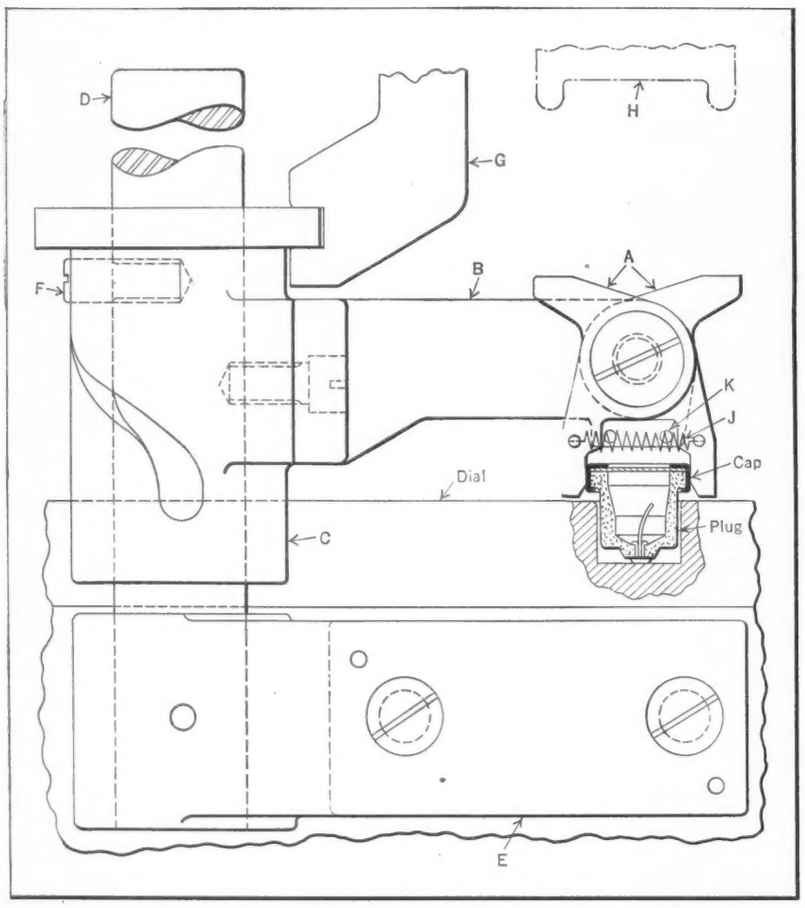
In winding typewriter ribbon on spools, a special device like the one shown in the illustration is used for stopping the rotation of the spool when a predetermined length of ribbon is wound up on it, at which time the ribbon is cut off. The spool is slipped on the end of the power-driven shaft *A*, and the ribbon is drawn from between the two rolls *B* and *C*. A coil spring (not shown), acting upon the upper roll, serves to keep a constant pressure of the rolls on the ribbon, so that as the ribbon is wound on the spool, both rolls are rotated.

Roll *C*, through the medium of the gears *D*, *E*, and *F*, rotates the chain sprocket *G*, over which the chain *H* is hung. Protruding from one of the links in this chain is the pin *J* which, through the levers *K* and *L*, disengages the clutch *M* from the driving pulley *N* and thus discontinues the rotation of the spool. The length of the ribbon wound on this spool depends upon the circumference of the roll *C*, the ratio of the gears, the number of teeth in the sprocket, and the number of links in the chain.

For every cycle of this chain, the pin depresses the lower end of the lever *K*, and in doing so, forces the upper end of the lever toward the right, allowing the hand-lever *L* to swing in a clockwise direction under the pull of the spring *O*. This hand-



Mechanism for Winding a Predetermined Length of Typewriter Ribbon on a Spool



Ejecting Device for a Dial Press which Lifts the Work from the Dial and Deposits it in a Container or Chute

Device for Ejecting Fuse Plugs from Dial Press

By J. E. FENNO

The illustration shows a device used for ejecting porcelain fuse plugs from the dial of a press. In this press, the plugs are assembled with the metal caps that retain the isinglass covers.

To eject the plugs, two spring fingers *A*, pivoted on the swinging arm *B*, are provided. The arm is mounted on a cam bushing *C*, the bore of which is a slide fit over the post *D* to allow vertical and rotary movement of the bushing. The post is stationary, and is secured to the press by means of the cast-iron bracket *E*. In the side of post *D* is secured the pin *F*, which engages the cam slot in the bushing and imparts the required oscillating motion to the arm *B* during the vertical movement of the bushing.

A flange at the top of this bushing engages the bracket *G*, which is secured to the press ram, so that as the ram reciprocates, the arm *B* will be given a combined vertical and oscillating movement.

As shown, the fingers *A* have gripped the plug preparatory to ejecting it from the dial. In this position, the ram is at its lowest point. As it ascends, the plug is lifted clear of the dial, and further upward motion of the ram causes the pin *F* to slide in the angular part of the cam groove and swing both bushing and arm enough to carry the plug over the edge of the dial. At this point the top ends of the two fingers *A* come in contact with the stationary stop *H*, which opens the fingers, allowing the plug to drop into a chute at the side of the machine.

From the chute, the plug slides into a container. A coil spring *J* is provided to give the required gripping pressure to the fingers. Also, in order to locate the fingers properly over the plug, centralizing pins *K* are provided. Although the stop *H* is shown in the illustration directly over the plug, this is not its actual position; it is placed at one side of the dial so that it will release the fingers only when they are above the chute.

lever is secured to the clutch member *M*, at the right-hand end of which is a cam-shaped projection engaging a similar projection on the stationary hub of the bracket *P*. As the end of lever *L* moves downward, the clutch member is oscillated on the shaft *A* and the cam projections are disengaged, allowing the coil spring *Q* to force the clutch member to the right and disengage its teeth from those of the driving pulley, thus discontinuing the rotation of the shaft and the spool.

To prevent further rotation of the rolls (due to inertia) after the clutch has been disengaged, the brake arm *R* is provided. This arm is attached to the pivot shaft of the lever *K*, so that just as soon as this lever has been tripped, or immediately after the clutch has been disengaged, the end of the hand-lever *L* swings downward and wedges against the edge of lever *K*, forcing the brake-shoe against the roll *C*.

In the design shown, roll *C* has a circumference of 12 inches, and the ratio of the gears and sprockets is such that when the roll rotates once, the linear movement of the chain is equal to the pitch of the chain. Hence, the number of links in the chain corresponds to the number of feet of ribbon upon the spool. Although designed primarily for winding typewriter ribbon, this device could doubtless be used successfully for many other applications.

* * *

Intermittent Rotary Motion Mechanism

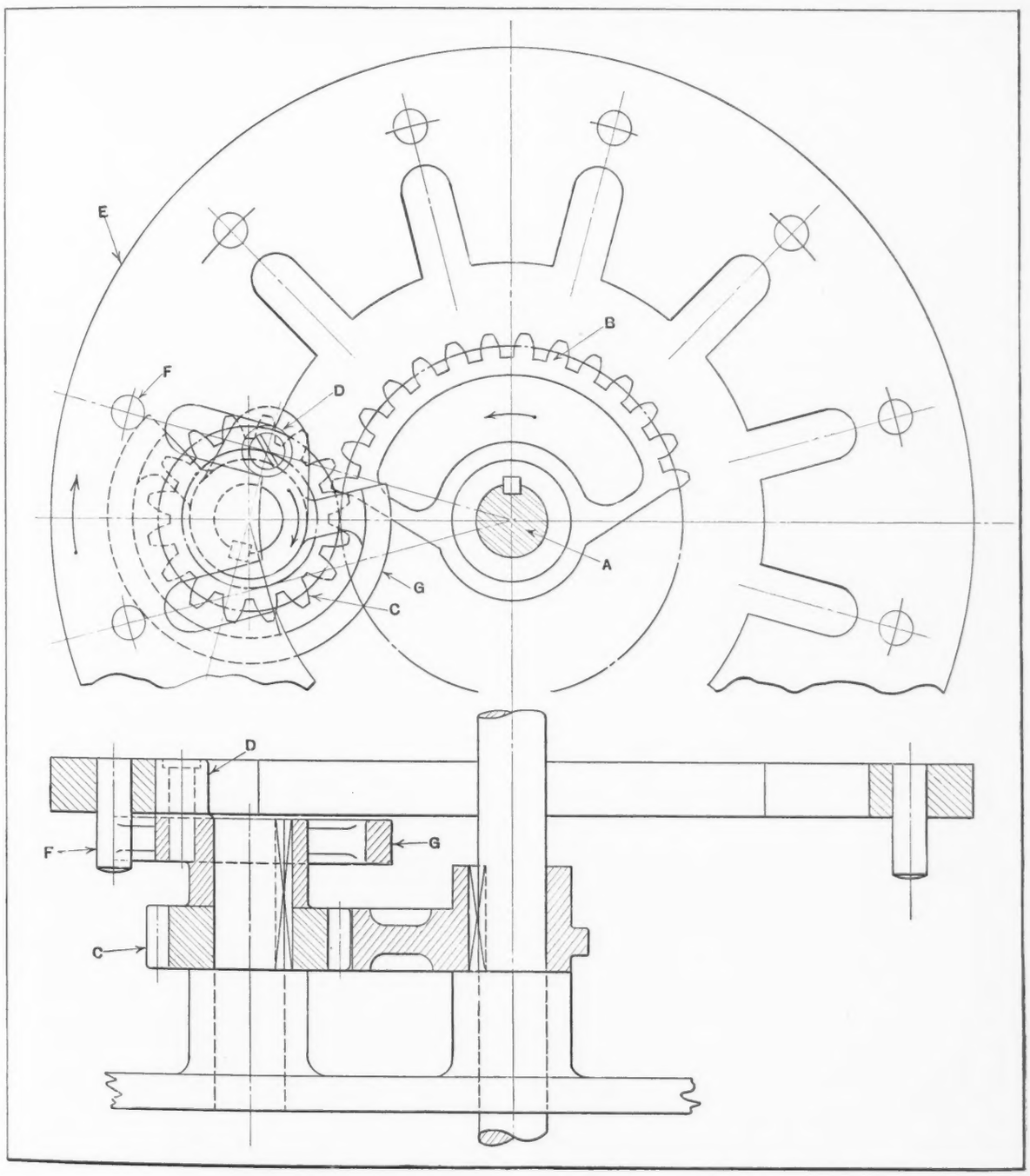
By J. A. DIXON

The mechanism shown in the accompanying illustration was designed to give a large heavy table or turret an intermittent rotary motion. This mechanism possesses all the advantages of a regular

Geneva motion and, in addition, provides for a much longer dwell between movements. The drive shaft *A* carries a gear segment *B* which contains just enough teeth to cause gear *C* to make one revolution. On the same shaft with gear *C* is a crank carrying a roller *D* which engages slots in plate *E*. Plate *E* is so mounted on the table or turret that it is free to revolve.

Plate *E* carries pins *F* which are engaged by the rim or periphery of the circular segment *G* which is a part of the crank. This action locks the plate *E* in position while the roller is out of engagement with the slots. By varying the number of teeth in the pinion, the size of the segment, and the number of slots, the length of the dwell period can be increased or decreased.

During the dwell period, while segment *B* is out of contact with the gear *C*, the roller *D* remains in the position shown in the upper view. If the mechanism is operated in the direction indicated by the arrows, very little shock is experienced when the segment comes into contact with the gear. This mechanism is adapted for moving heavy loads, as the power is applied near the periphery of the table.



Mechanism for Producing Intermittent Rotary Motion for a Heavy Table

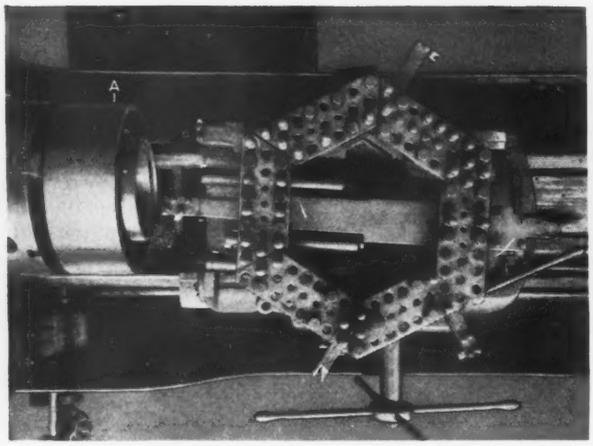


Fig. 1. Set-up for Taking First Roughing Cuts on Flange Side of the Pulley

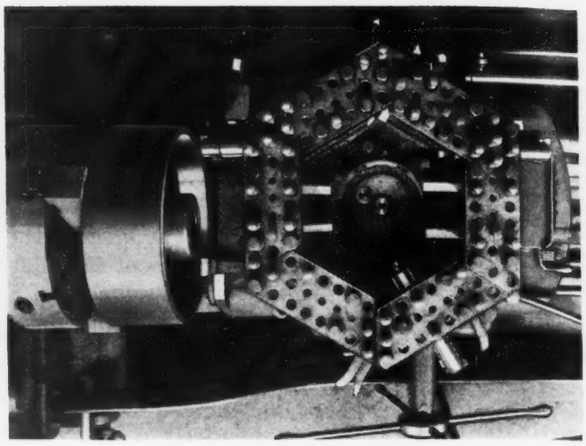


Fig. 2. Set-up for Rough- and Finish-machining the Hub Side of the Pulley

Tooling Equipment for Clutch Pulley

Methods Employed in Machining the Main Drive Clutch Pulley for a Multiple Disk Lathe Clutch

By H. T. LAFFIN
Jones & Lamson Machine Co., Springfield, Vt.

EVERY machine tool shop must produce, economically, the pieces that go into the manufacture of its own products. Many of these parts are more or less complicated and require unusual machining methods and equipment. The size of the piece, the number of surfaces to be finished, and the limits of accuracy within which it is necessary to hold the work are all elements that contribute to the problems of the foreman or superintendent who is responsible for production.

How an interesting machining problem of this kind is handled at the plant of the Jones & Lamson Machine Co., Springfield, Vt., is described in this article. The part to be machined, which is shown in the rough or semi-finished state at *A*, Fig. 1, and nearing completion in Fig. 11, is the main drive clutch pulley for the multiple disk clutch of a lathe. The pulley of this clutch is 15 inches in diameter and has a 5 1/4-inch face. The rough casting is delivered directly from the foundry to a turret lathe equipped as shown in Fig. 1. For the first machining operation, the work is gripped in special

Fig. 3. Finishing the Rough-Machined Surfaces to Improve the Balance

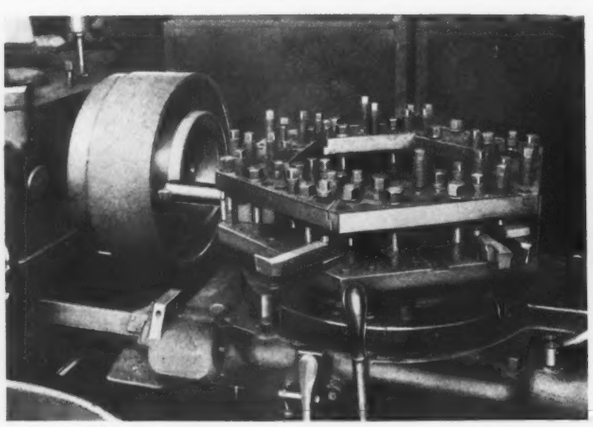
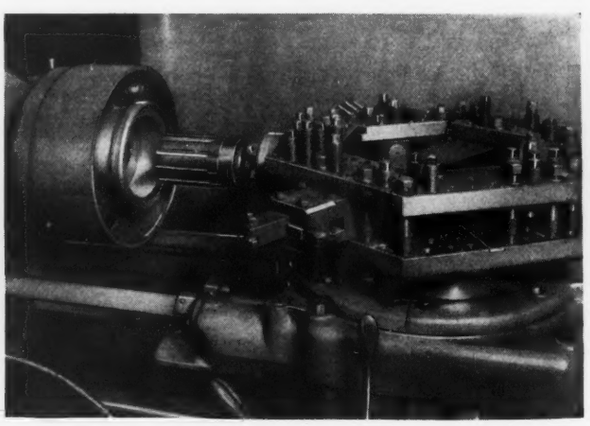


Fig. 4. Turret Lathe Equipped for Boring and Reaming the Pulley



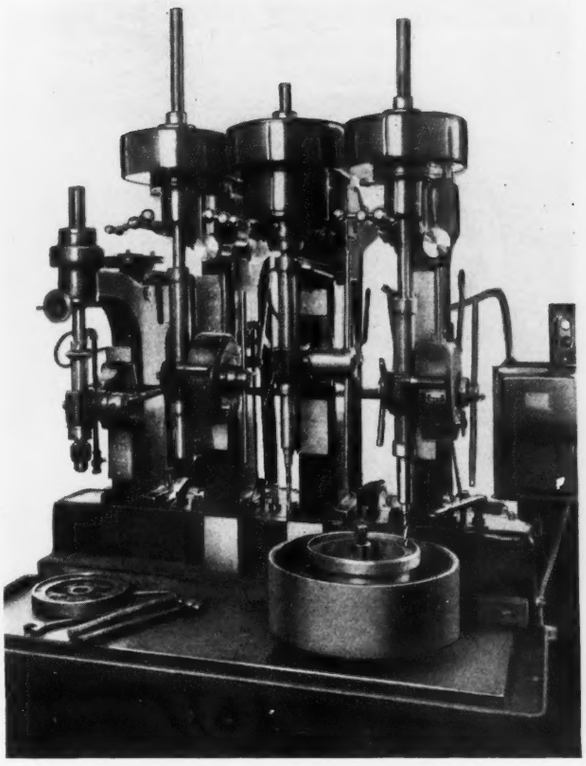


Fig. 5. Drill Press in which the Holes in the Pulley Flange are Drilled

Fig. 6. Removing Stock from Cored Holes in Web to Obtain Balance

jaws which enter the cored holes in the web. In this operation, the inside of the pulley is rough-bored, the outside of the flange rough-turned, the inner surface of the rim rough-bored, and one side of the web and the back of the flange rough-faced, leaving about 1/16 inch on all surfaces for finishing. The turret lathe set-up for performing the second operation is shown in Fig. 2. For this operation the pulley is gripped on the outer surface of the flange while rough- and finish-facing and cham-

Fig. 7. Taking a "Split Cut" in Rough-turning the Crown of the Pulley

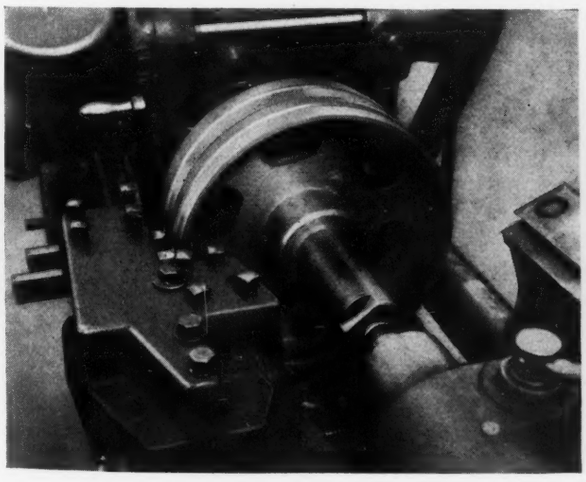
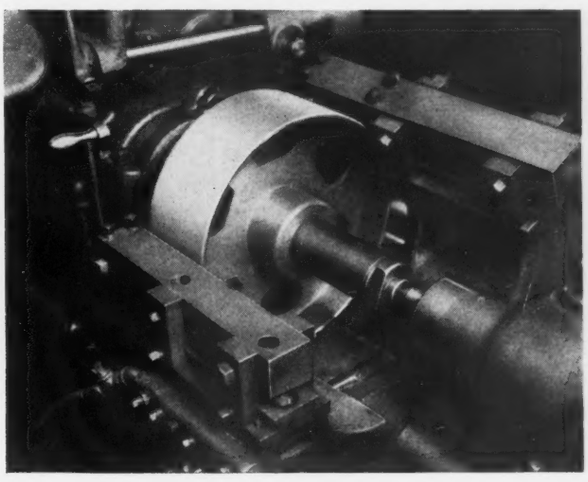


Fig. 8. Turning the Crown the Full Width by the Use of a Profiling Tool



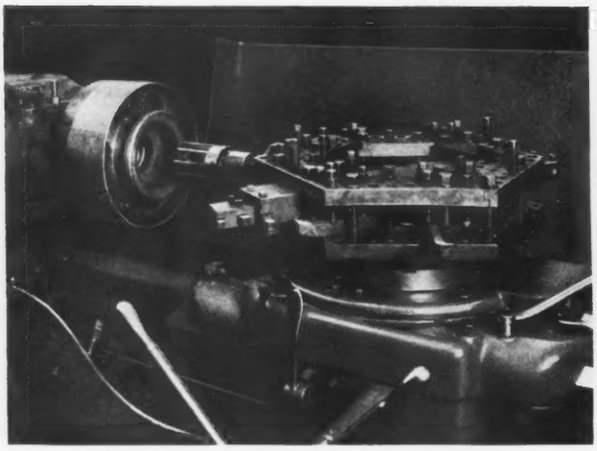


Fig. 9. Finish-boring and Reaming Operations on the Flange Side

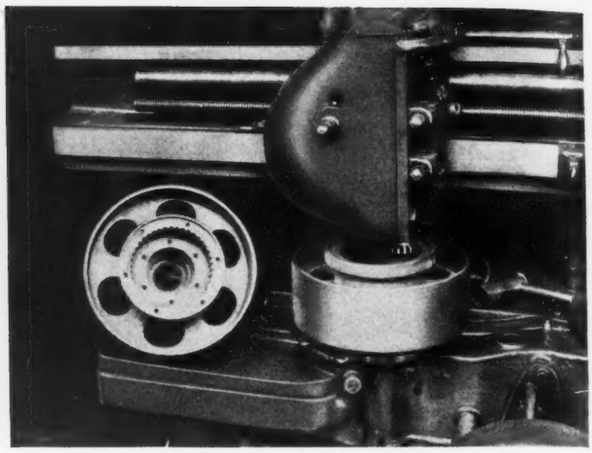


Fig. 10. Cutting Internal Teeth for the Clutch Disks on a Gear Shaper

fering the hub, rough- and finish-turning the hub, facing the web, rough- and finish-turning the inner surface of the rim, and chamfering the end.

The third operation is performed in a turret lathe equipped as shown in Fig. 3. Here the hub of the work is located in a special faceplate fixture and held in place by a nut and washer on a draw-rod which passes through the spindle. All surfaces machined in this operation have previously been rough-turned and are being machined for balance only. These operations consist of finish-boring the inner surface of the rim, finish-turning the flange, and finish-facing the web.

In the fourth operation, illustrated in Fig. 4, the pulley is located the same as in the previous operation, and driven by studs and clamps which pass through the cored holes in the web. All the inner surfaces and holes are semi-finish-bored. Two holes that are used for locating the work on an arbor in a subsequent operation are also reamed to a uniform size.

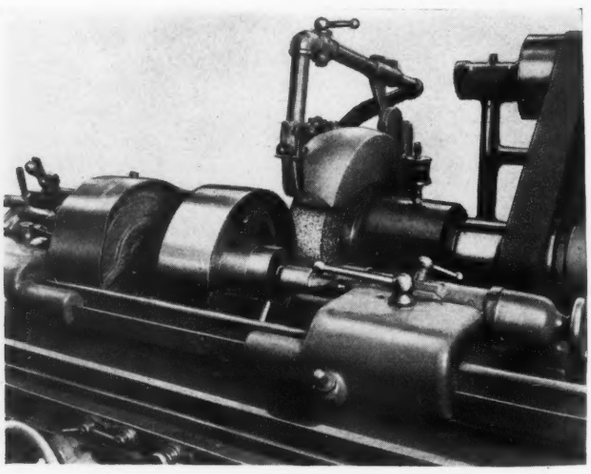
For the fifth operation, the pulley goes to the drill press shown in Fig. 5, where six 3/8-inch holes are drilled in the flange. These six holes must be tapped before the pulley is finished, but the tapping is not done in this operation, as the holes receive the pins that drive the work in the succeeding operation, which is performed on a Fay automatic lathe.

Turning Pulley Crown on Automatic Lathe

The crown of the pulley is rough-turned in the sixth operation on a Fay automatic lathe equipped as shown in Fig. 7. This illustration shows the carriage tooled up for "splitting the cut," which

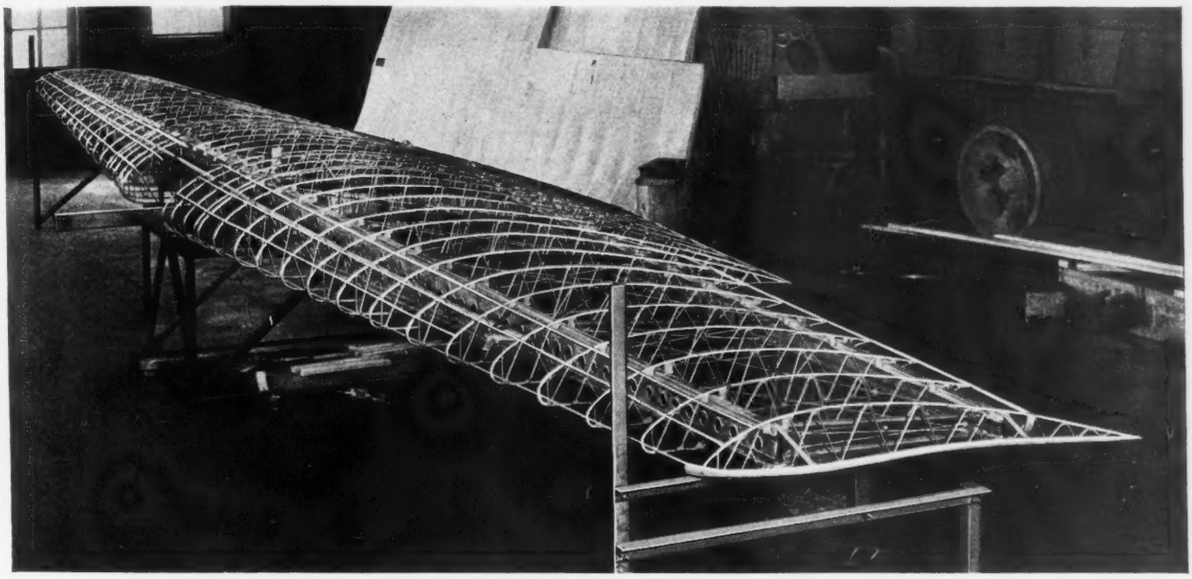
Fig. 11. A Sensitive Drill is Employed for Drilling and Tapping Some of the Holes

Fig. 12. Giving the Crowned Face of the Pulley a Final Finish on a Grinding Machine



allows the entire width of the pulley to be turned with a carriage travel equivalent to only half the width of the pulley. For this operation, the pulley is held on a special arbor, the locating and driving of the work being accomplished by six pins which engage the six 3/8-inch holes drilled in the fifth operation.

The finish-turning operation on the crown is also performed on a Fay automatic lathe, equipped as shown in Fig. 8. The entire width of the pulley face is turned in this operation with one profiling tool, which produces the required crown while tools in the back arm straddle-face and chamfer the sides of the pulley rim. The outside of the pulley thus finished is now concentric with the inner surface.



An Airplane Wing Frame Made from Non-corroding Alloy (Allegheny Metal). Tests Indicate that a Wing of this Type will have 25 Per Cent Greater Strength than Former Designs. In Addition, Safety is Promoted by the Elimination of Corrosion

The work is next taken to a turret lathe tooled as seen in Fig. 9, where it is clamped in a special fixture, the hub and outer rim of the pulley being used as locating surfaces. In this operation, the inner surfaces of the pulley are finish-bored and reamed, and all faces finished, including necks, recesses, and chamfers.

The succeeding operation consists of placing the work on a special fixture in a Fellows gear shaper and cutting the internal teeth, as shown in Fig. 10. Following this operation, a sensitive drill is employed, as shown in Fig. 11, for drilling and tapping holes.

For the eleventh operation, the work is held on a special grinding arbor, as shown in Fig. 12. In this operation the crown is given the final finish by grinding, and both faces of the rim are also ground. The next operation, which consists of balancing the finished clutch pulley, is performed by the aid of balancing ways and the drill press shown in Fig. 6. An end-mill is used to remove stock from the cored holes in the web in order to obtain static balance. This completes the operations on the pulley.

* * *

Effect of Length of Chamfer on Taps

In a paper relating to cutting tools for interchangeable manufacture, read by E. J. Bryant, manager of the gage and reamer departments of the Greenfield Tap & Die Corporation, before the Machine Shop Practice Division meeting of the American Society of Mechanical Engineers at Hartford, Conn., the author pointed out that the length of chamfer on a tap has an important bearing both on the size of thread produced and on the life of the tap.

The same length of chamfer will not produce the best results in all materials and under all conditions. The short-chamfer tap has a tendency to cut over size—the long-chamfer tap cuts closer to size. For tapping cast iron and brass, a tap with only one or two threads chamfer is the best. For tapping steel, a tap with a longer chamfer is desirable and sometimes necessary. The alignment of the spindle with the hole to be tapped is an important feature. Some production engineers state that tap breakage is mainly due to defects in alignment.

The necessity of a suitable lubricant for tapping cannot be over-emphasized. Lubricants with a high sulphur base have been found to cut considerably over size. Of course, all taps cut a thread larger in diameter than the tap itself. In steel and iron, a tap cuts at least 0.001 inch, and frequently from 0.002 to 0.003 inch over size.

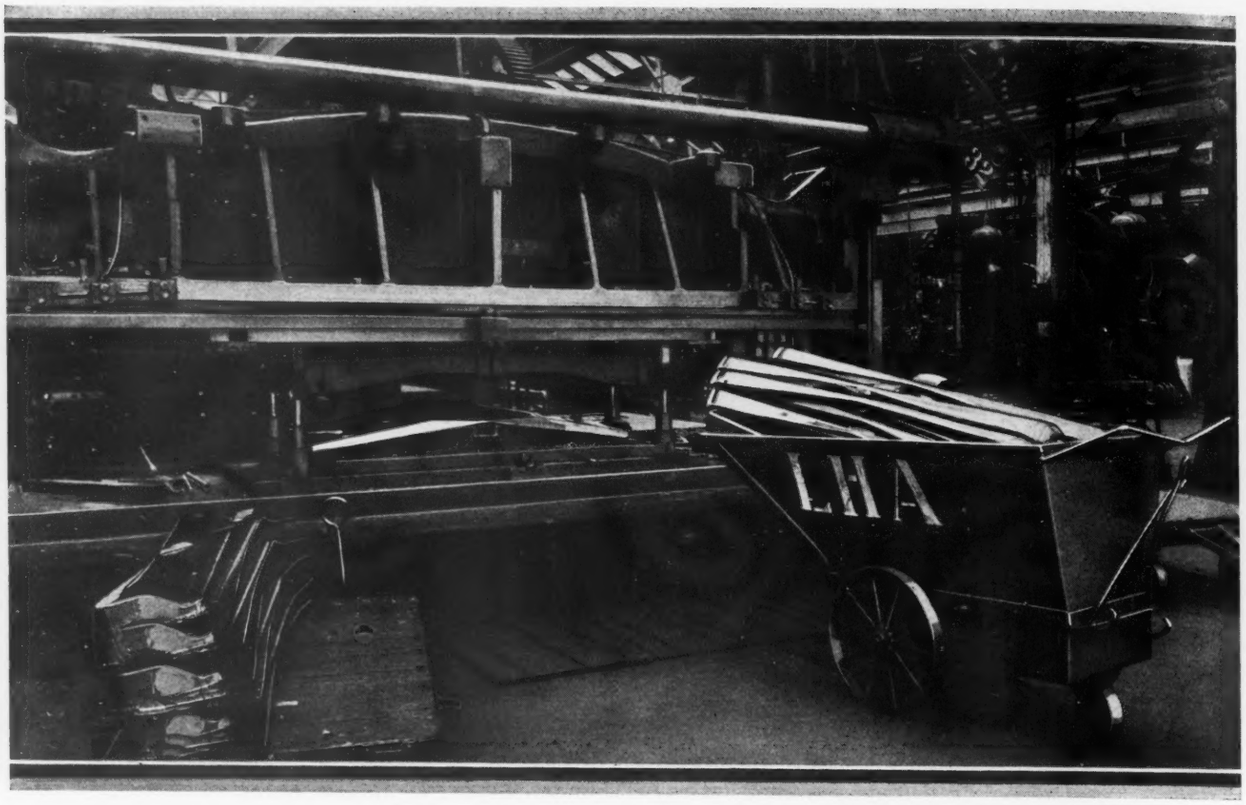


Fig. 1. In the Stamping Plant, All the Metal Scrap is Placed Directly into the Conveying Buggies

There Is No Waste

The Illustrations Show What Happens to Metal Chips and Sheet-Metal Trimmings in a Great Automobile Plant. The Text Tells What the System Illustrated Has Accomplished*

By R. R. REES, Manager
Packard Motor Car Co.

"SCRAP," in the sense that it implies waste, has become practically an obsolete word in the plant of the Packard Motor Car Co., where the system here described and illustrated has been established. The basic principles applied so successfully in this large plant are obviously applicable in other plants.

During the last few years, tremendous progress has been made in automobile manufacturing methods. Great advances have also been made in waste elimination. In the case of the Packard Motor Car Co., a separate department turned its attention to the problem of waste elimination and the salvaging of materials. One of the first steps was to establish a salvage division, which served as a clearing house for all scrap, obsolete materials, machinery, and equipment. It was the duty of this department first to find a use for as much of the salvaged material as possible in the plant itself, and then to find the most profitable market for all remaining materials.

One duty of the salvage department was to prepare accurate records of scrap. These showed that there was an excessive amount of scrap. Accordingly, steps were taken to reduce the amount of scrap by improving the tool equipment and the methods of handling the work. This resulted in a great reduction in the amount of metal scrap. The more important salvage problems, however, which were concentrated on from the beginning, were the baling of sheet and strip steel and the briquetting of steel and cast-iron chips and borings.

How Sheet Steel Trimmings are Baled and Loaded on Cars

Originally, the metal scrap from the presses in the stamping plant was loaded into large steel buggies, such as shown in Fig. 1. When filled with scrap, these buggies were pushed to the outside of the building, where they were unloaded by hand into a large truck belonging to a local scrap dealer. On arriving at the scrap dealer's yard, the material was again handled before being shipped to the mill.

*Abstract of a paper read before the National Management Congress of the American Society of Mechanical Engineers at Cleveland, Ohio.

Fig. 2. The Buggies Filled with Metal Scrap are Emptied into a Hopper

An engineering study of this method of disposing of the scrap resulted in the installation of a baling press in a specially constructed building adjacent to the stamping plant. This press is located at floor level, as shown in Figs. 2 and 3, to permit the scrap metal to be dumped directly into the receiving hopper from the buggy. When a sufficient amount of scrap is in the hopper, the hydraulic press is operated, causing the scrap material to be formed into a bale 14 by 20 by 20 inches in size, weighing approximately 500 pounds.

From the press, the bales are discharged automatically on a slat conveyor which carries them outside the press building to gondola railroad cars, as shown in Fig. 4, for direct shipment to the mills. Thus, the metal is not touched by hand from the time it leaves the stamping press until it reaches the railroad car ready for shipment. This method represents a large saving of labor, and in addition, there is a marked increase in the price paid for the baled metal.

During the year 1929, more than 9800 gross tons of metal scrap were baled, representing a net return on the investment of 150 per cent. In addition to the financial return, considerable floor space was saved because of the large area previously taken up by the accumulation of scrap steel.

Method of Handling Steel Turnings and Borings

Such gratifying results were obtained in salvaging cast-iron turnings and borings by the installation of the chip-disposal system described in September, 1929, MACHINERY, page 41, that attention was turned to the salvaging of steel turnings and borings. The original method of handling this scrap was to collect the steel turnings in small buggies in the various departments and transfer them to a central location, where they were forked into large trailers and moved to a local scrap dealer who purchased this material for a very small price.

In investigating this subject, it was discovered that the chips contained a sufficient amount of oil to make the installation of oil-extracting, filtering, and reclaiming equipment a profitable investment. The chips produced in the machining operations usually take the form of short irregular shapes, long strings, or tight coils. These shapes are bulky and difficult to

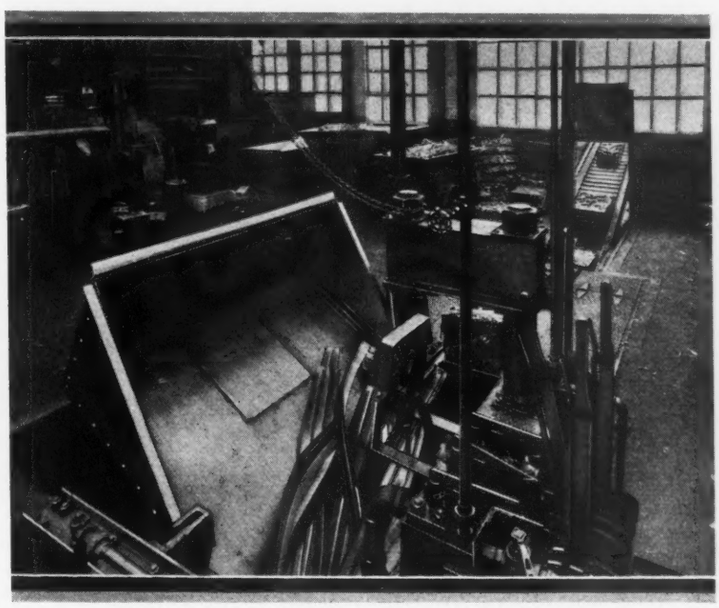


Fig. 3. When Properly Loaded, the Hopper Discharges into the Press of the Baling Machine

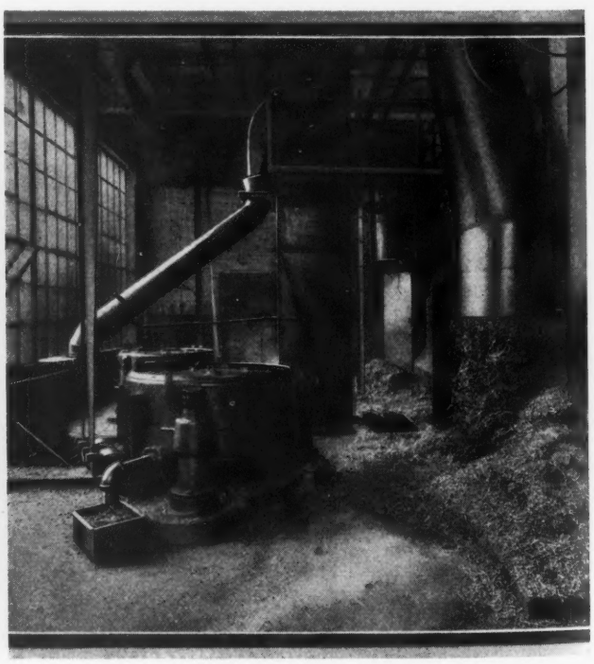
Fig. 4. From the Baling Machine, the Compressed Bundles of Scrap are Carried by Conveyors to Railway Cars. Thus, the Scrap Metal is not Touched by Hand from the Time it Leaves the Press until it is on the Cars Ready to be Shipped to the Mills

handle. By installing equipment for crushing the chips, it became possible to handle them more efficiently.

After the crushing operation, it was found that the weight of the chips per cubic foot was still comparatively low and that by briquetting this material in a manner similar to that employed for cast iron, additional savings could be made. The steel salvage station was, therefore, equipped with oil-extracting, crushing, and briquetting machinery. This station was located as near as possible to the machine departments that produced the greater part of the chips. The salvage station was of reinforced concrete, and built at one side of the five-story building. The first floor contained the crusher and briquetting machine, and the second floor, the receiving station, extractors, and overhead bins.

Steel chips from each of the five floors of the adjoining building are conducted through 24-inch steel chutes on the outside of the building to the second floor of the salvaging station. The chips are collected at the machines by small steel buggies and transferred to the chutes, into which they are dumped by hand, as shown in Fig. 5. The steel chips are piled up on the second floor and are raked from this position to a hole in the floor through which they fall into a crusher hopper located on the floor below. After being crushed, the chips are carried up a bucket elevator, which delivers them to an overhead hopper on the second floor.

Figs. 5 and 6. (Below) Left: Steel Chips are Transferred to Chutes by Buggies. Right: The Chutes Discharge their Loads on the Second Floor of the Salvage Building, where the Oil Extractors are Located. Overhead Monorail Hoists Provide for Raising and Dumping the Extractor Baskets into a Chute Leading to a Baling Machine



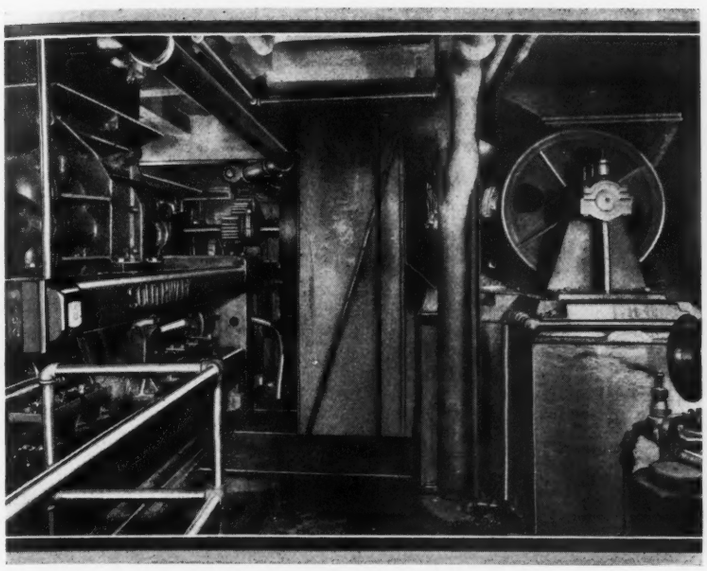


Fig. 7. On the Second Floor, the Chips Are Emptied into a Hole which Feeds into the Crusher on the First Floor. From the Crusher, Shown at the Right, a Bucket Elevator Raises the Chips to an Overhead Hopper on the Second Floor. From this Hopper, the Chips Flow by Gravity Either to the Oil Extractors or Directly to the Briquetting Machine, Shown at the Left

From this hopper, it is possible for the chips to flow by gravity to either of the extractors on the second floor, Fig. 6, or directly to the hopper of the briquetting machine, Fig. 7, which is located on the first floor. When the chips are put through the extractors, the extractor basket is lifted by an overhead monorail hoist and dumped into the briquetting hopper at floor level. After leaving the briquetting machine, the briquettes drop on a slat conveyor, Fig. 8, which, in turn, dumps them into large steel trailers, such as shown in Fig. 9. As fast as the steel trailers are filled, they are made up into trains and are hauled to the north part of the plant where their contents are dumped into gondola cars for shipment to the mills.

Many different types of steel are used in the automobile industry. It was found impossible to form some of the tougher steels into briquettes without mixing them with steel chips from softer materials. By properly mixing the different materials, however, all the chips could be formed into briquettes.

The quantity of oil reclaimed from the steel chips amounts to 140,000 gallons per year, representing a net return of 18 per cent on the investment. Under normal conditions, 2700 tons of steel chips are produced per month, or 32,400 tons per year. The market value of briquetted chips is about 60 per cent more than for bulk chips, and this item represents a net return on the investment of 42 per cent, or a combined total for the oil and briquettes of 60 per cent.

Salvaging Miscellaneous Materials

In 1929, there were sold, out of the salvage department, such materials as carpet, cotton, canvas, leather, and upholstery clippings, nonferrous metals, waste paper, accessories, and miscellaneous paper cartons, barrels, and nail kegs, which represented a revenue that ran into six figures.

Another interesting salvage item is the accumulation and burning under the steam boilers of all wood-mill refuse, as well as unused wood material such as crating boxes, etc. In 1929, steam was produced in wood-fired boilers from this material, representing a saving of 13,300 tons of coal. In addition to this, the salvage of wood material taken from crates, boxes, etc., and re-used in the shipping department amounted to over 315,000 feet of lumber.

"When is a salvage department justified as a part of a manufacturing organization?" is a frequently discussed question. Some believe that such a depart-

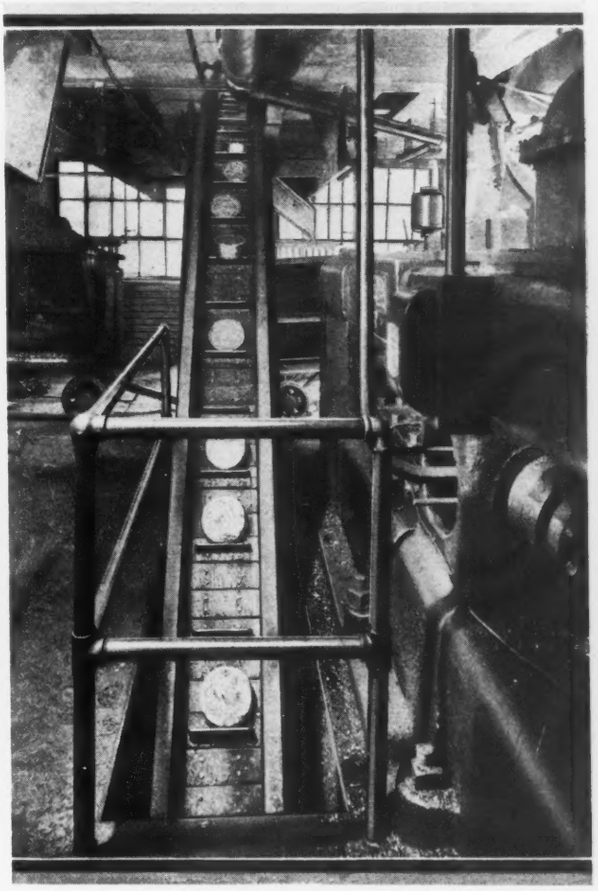


Fig. 8. Upon Leaving the Briquetting Machine, the Briquettes Drop on This Slat Conveyor which Dumps them into Steel Trailers

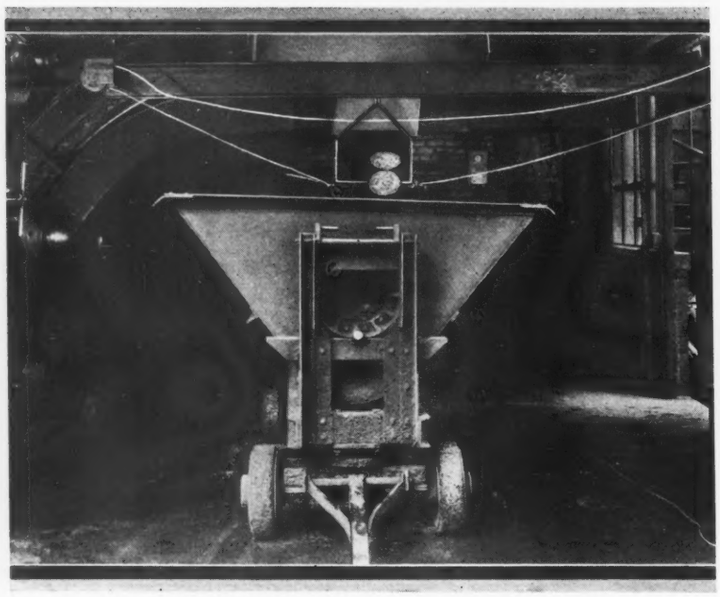


Fig. 9. Here the Briquettes are Delivered to Quick-dumping Trailers which are Hooked up in Trains as Fast as they are Loaded. The Trailer Trains are Hauled to the Railway Siding, where the Briquettes are Dumped into Gondola Cars for Shipment to the Steel Mills

ment is only justified in the larger plants where large volumes of scrap material are handled. Such a statement, it appears, is only partially true. While the salvaging of materials in large plants is obviously a very important problem, the author believes that even the smallest manufacturing organizations can well afford to have one man devote his time to this work.

* * *

A New Rust-Preventive Paint

News comes from England of a new paint for application to iron and steel, a single coating of which, it is claimed, will completely protect those materials against rusting or corrosion by the atmosphere, sea-water, smoke, gases, or acids. The paint, which is known as "Nust," is applied by means of a brush to the cleaned surface of the metal, and is understood to consist essentially of a suspension of collodial lead in linseed oil. The finely divided lead, it is stated, combines with the iron to form a permanent continuous coating, which will not crack or peel off if the iron is bent to a small radius or stretched so as to increase its length by as much as 1 per cent.

Plates protected with "Nust" have, according to *Engineering*, been exposed to a moist atmosphere, containing nitric and hydrochloric acids, for a period of three years without corroding. The color of "Nust" paint is battleship gray, but it can be used as a priming coat over which other paints can be applied. The paint is manufactured in Bristol, England, by the No-Rust Liquid Lead Co., Ltd.

Determining the Correct Distance Between Pulley Centers

By W. F. SCHAPHORST

The problem of determining the correct center distance between pulley shafts is frequently encountered. One important factor that is often overlooked in this connection is the fluctuation in the load. If there is no fluctuation and the belt is subjected to a steady load, the pulley shafts can usually be placed as close together as their dimensions will permit. If, however, the drive is subjected to shock by suddenly applied or fluctuating strains, the distance between the shaft centers must be increased in proportion to the severity of the shock.

A belt possessing a high coefficient of friction and a high degree of elasticity should always be used for drives subjected to sudden changes or fluctuations in the amount of power transmitted. If, however, there is no fluctuation in the load, belt elasticity is of little or no value. In fact, it is generally a liability rather than an asset where the load is constant. Elasticity allows the belt to creep, a characteristic which is closely allied to "belt slip." It has been repeatedly demonstrated that with the modern high-friction belt, the distance between centers is of less importance than provision for an ample arc of contact, and the present-day wrapper-pulley drives are handling all kinds of loads at extremely short center distances.

* * *

When Dimensions Are Not to Scale

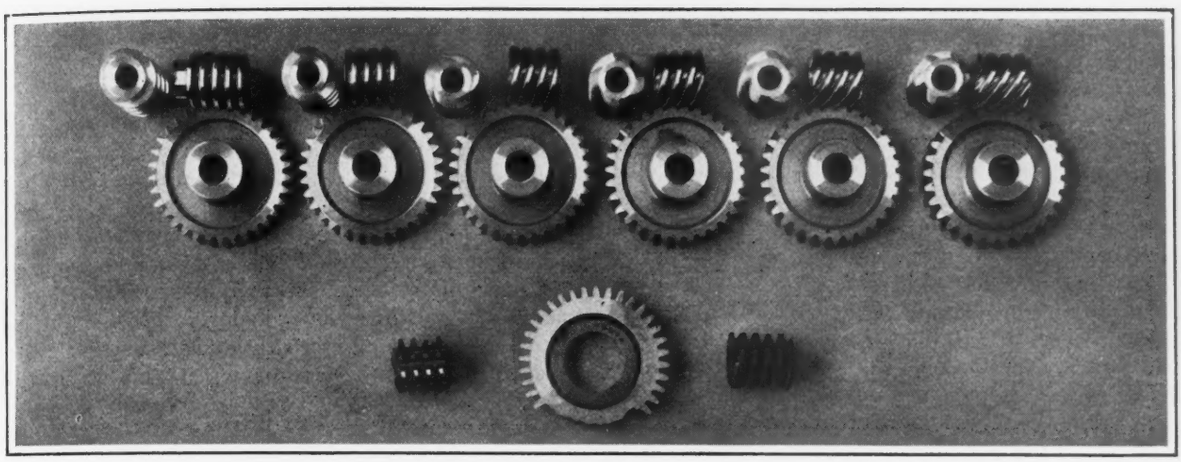
By F. E. FICK

The following comment on the idea expressed in the article "When Dimensions Are Not to Scale," published on page 690 of May MACHINERY, may be of interest. It is advocated to underscore all dimensions that are not to scale; my comment concerns the style of the underscoring.

In our engineering department, we use a wavy line beneath the dimension figure in preference to a straight line. Our reason is that a straight line is used as a means for underscoring when it is desired to lend special emphasis to a figure, word, or statement. It is, therefore, confusing to use this style of underscoring for a different purpose, that is, to denote that a dimension is not to scale. By using a wavy line, a distinction is made and misunderstanding is prevented.

* * *

Change does not always mean progress; but progress always means change. He that fears change, fears progress.



Cutting Worm-Gears with Standard Spur-Gear Cutters

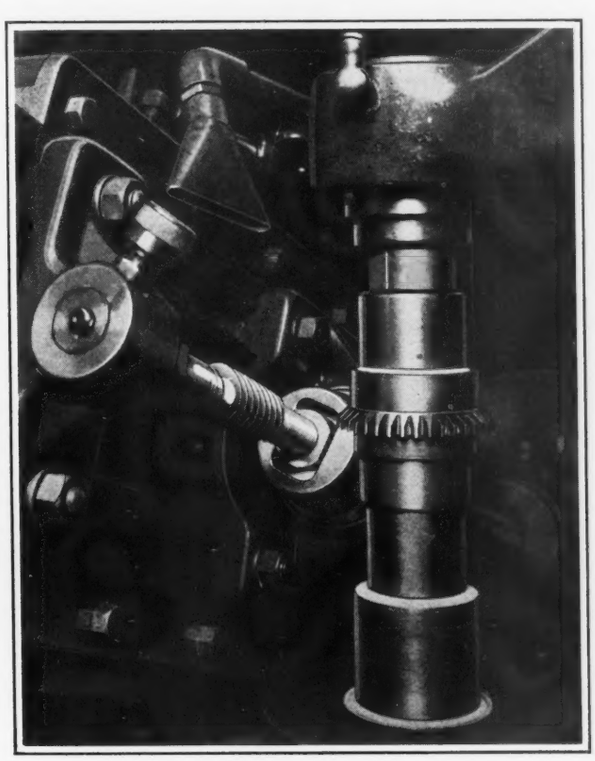
By C. DAHLERUP, Superintendent, Atlantic Gear Works, Inc., Brooklyn, N. Y.

IN cutting worm-gearing, it is often possible to use standard spur-gear cutters of the required diametral pitch and avoid the use of hobs made to special circular pitches. The heading illustration shows six sets of worm-gears with worms having from one to six threads. These gears are alike as to center distance and pitch. The center distance is 1 7/8 inches, the diametral pitch 12, and all worms have a pitch diameter of 1 inch. The ratio of the single-threaded worm-gear at the left is 33 to 1, and of the six-threaded gearing at the right 4 5/6 to 1, with intermediate ratios between these extremes.

An interesting fact about the six sets of gearing referred to is that all the worms were cut with an old Fellows gear-shaper cutter of 12 diametral pitch, and all the worm-wheels were cut with a single-threaded hob of similar pitch. This work was done on a Reinecker universal gear-hobber, using the tangential feeding attachment. The hob and gear-shaper cutter are shown in the lower part of the heading illustration. The latter happens to have several teeth broken out, but this did not interfere with its use.

Method of Threading the Worms

When the machine is set up for threading a worm, the worm is placed on the cutter-arbor and the head is set to the helix angle of the worm (see illustration). The Fellows spur-gear cutter (14 1/2 degrees pressure angle) is placed on the work-arbor with the cutting edges downward in order to clear the chips. The machine is geared to suit the number of worm-threads. The spur-gear cutter originally had 36 teeth, which is the number considered in figuring the gears. In threading the double-threaded worm, the machine is geared for half the number of teeth in the cutter, or the same as it would be for hobbing a spur gear of 18 teeth using a single-threaded hob. For a triple-threaded worm,



Gear-hobber Set up for Threading Worms, Using a Standard Fellows Gear Shaper Cutter for the Threading Tool

the machine would be geared for 12 teeth, and for a quadruple-threaded worm, it would be geared for 9 teeth, and so on.

In cutting a single-threaded worm, the worm is given a feeding movement or revolution equal to the *axial* pitch of the hob. As the *normal* pitch of a spur-gear hob equals the circular pitch of the gear, the corresponding axial pitch of the hob must be determined. In the case of a double thread, the normal lead of a hob of 12 diametral pitch is 0.5236 inch, and the lead angle is 9 degrees 29 minutes; hence, the linear pitch in the plane of the axis is 0.5308 inch. The tangential feed, then, for a double thread is 0.5308 inch per revolution. The worm-wheels that are to mesh with these worms are somewhat larger than standard spur gears of the same pitch, as they are proportioned the same as spiral or helical gears. If the resulting increase in center distance is too great, the worm size may be reduced somewhat, although it should be practically the same as that of the hob.

Worms with single, double, and triple threads can be cut to the proper helix angle; but if there are more than three threads, the angle should be modified to avoid excessive under-cutting of the tooth. This correction of angle is equivalent to from 30 to 45 minutes for each thread. For example, if a six-threaded worm has a helix angle of 29 degrees 3 minutes, then the actual cutting angle would be $6 \times 45 = 270$ minutes, or 4 1/2 degrees larger—namely, 33 degrees 33 minutes; but the lead for cutting the worm would be based upon the correct angle of 29 degrees 3 minutes. The effect of this correction is to increase the pressure angle of the worm, thus avoiding under-cutting. Any pressure angle up to about 30 degrees can be obtained in this way with a standard 14 1/2-degree cutter.

Cutting the Worm-Wheels

The six worm-wheels shown in the heading illustration all have a pitch diameter of 2 3/4 inches. These worm-wheels were cut with a 12-pitch spur-gear hob of 1-inch pitch diameter and 14 1/2-degree pressure angle. The hob is set to conform to the helix angle of the worm, and the machine is geared to suit the number of teeth. The number of teeth varies in this case from 29 to 33 for the same pitch diameter, because, as the helix angle increases, the smaller the number of teeth of the same normal pitch becomes for a given pitch diameter.

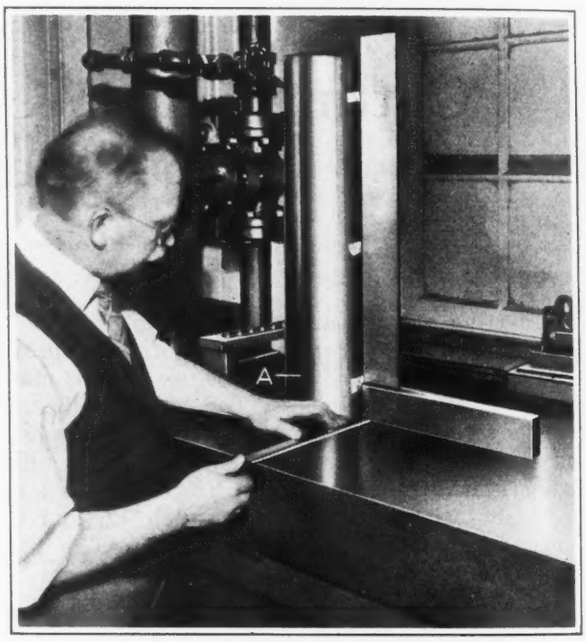
The heading illustration shows, at the right of the Fellows cutter, a worm of Hindley form, except for the outside diameter. This worm was cut by gearing the machine the same as for a straight worm, and feeding the worm vertically instead of axially past the cutter.

While the foregoing method of cutting a series of single- and multiple-threaded worm-gears with standard spur-gear cutters results in more or less inaccuracy of tooth form, it is sufficiently accurate for many classes of work; and, when greater precision is required, the hob can be utilized for roughing and a fly cutter for finishing.

Convenient Method of Checking Steel Squares

In one of the tool-rooms of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., the simple method here illustrated is employed for checking steel squares. A hollow cast-iron cylinder *A*, 6 inches outside diameter and about 2 feet high, is used for this purpose. One end of the casting was ground square with the cylindrical surface to an accuracy within 0.0005 inch. A center line was then scribed along the cylindrical surface.

Before checking a square, the bottom end of casting *A* and the surface plate are carefully



Checking Steel Squares by the Use of an Accurately Ground Cylindrical Casting

cleaned. Then the square is set up as shown, with one leg coinciding with the center line on the cylinder, and the bottom leg parallel with the front edge of the surface plate. This parallelism is determined by means of a steel scale.

Strips of a fine grade of paper 0.00075 inch thick, having a slight gloss, are placed between the steel square and the cylinder at three points as shown. If any of the strips can be pulled out while one is held tight, the square is evidently inaccurate at the points where the strips are loose. The actual amount of inaccuracy can be determined by slipping several thicknesses of paper or feeler gages between casting *A* and the square.

Squares for ordinary use may be inaccurate to the extent of 0.001 inch, but for some work the accuracy is held to 0.0005 inch. When the inaccuracy exceeds the maximum limit, the square is returned to the manufacturer for truing.

Machine for Rifling Four Revolver Barrels Simultaneously

By AVERY E. GRANVILLE

Fig. 1. Revolver Barrels, Showing Operations Performed before They are Rifled in the Machine Illustrated in Fig. 2

FOUR revolver barrels, which are shown in the preliminary stages of their manufacture in Fig. 1, are rifled simultaneously in the machine illustrated in Fig. 2. This operation consists of cutting five shallow equally spaced helical grooves in the reamed bore of each barrel. Fifteen minutes is the time required for rifling each bore, and this includes the time taken in handling as well as in sharpening and setting the cutters.

Four chucks *A*, Fig. 2, are mounted on the ends of their respective spindles, and in the jaws of these chucks are gripped the muzzles of the barrels. The rifling tools *C*, secured in the socket-holders *B*, pass back and forth in the barrel bores and cut the grooves during the draw strokes. These tools, each of which is equipped with a grooving cutter, are a slip fit in the bores of the barrels, and they are given a reciprocating movement by means of the crank *D* and connecting-rod *E*, which is pivoted to the slide *F*.

In this slide are assembled four shafts, the ends of which form the socket-holders. A gear on each of these shafts meshes with the rack bar *G*, and when the slide *F* is in motion, a lateral movement is imparted to the bar by a stationary cam at the rear of the machine (see Fig. 3), causing the socket-holders to rotate. Thus a combined rotary and straight-line movement is transmitted to the rifling tools, guiding the cutters in a helical path.

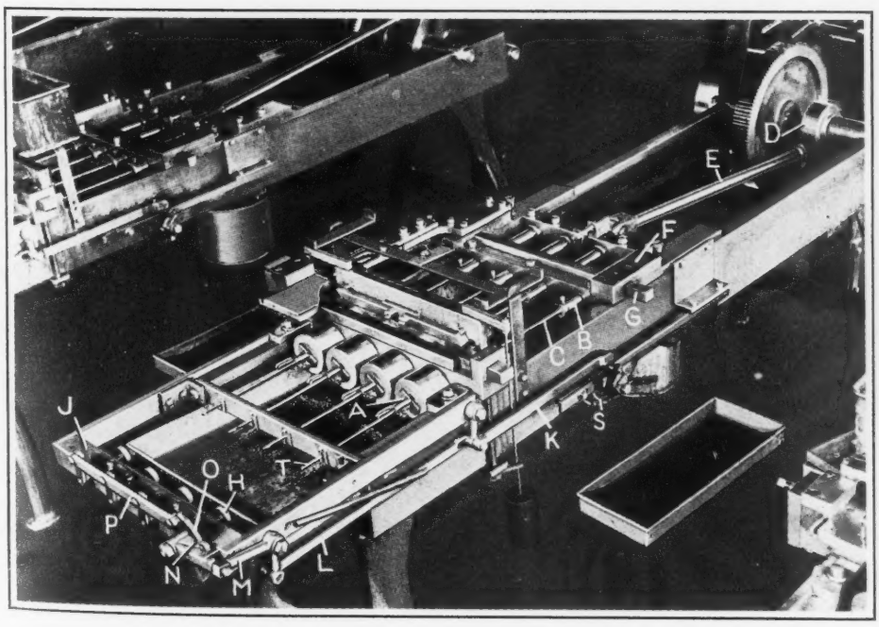
Feeding the Cutters Radially

From the cutter end of each rifling tool projects a slender rod *T*, which, when telescoped into the body of the tool, forces the grooving cutters outward. This radial movement is imparted to the cutters as the tools approach the end of their idle stroke, at which time the ends of the rods come in contact with the stops *H*.

Each stop is secured to the end of a short screw in the stationary bracket *J*, and in order to feed the cutters radially at the end of each idle stroke, the screws are given a partial rotation after each cutting stroke through the movement imparted by slide *F* to the links *K* and *L* and the cam-wheel *S*.

Cam-wheel *S* is so designed that for every five revolutions of crank *D*, link *L* is moved toward the left and then back again. Link *L*, in turn, oscillates the bell-crank lever *M*, connected to the ratchet pawl *N*, and causes the ratchet segment *O* on the first stop-screw to ro-

Fig. 2. Rifling Machine for Cutting Five Equally Spaced Grooves around the Bore of the Revolver Barrels Shown in Fig. 1



tate with the screw a partial revolution. Short levers secured to the ends of the remaining stop-screws are linked to the segment by the bar *P;* consequently, all the screws rotate the same amount and carry the stops an equal distance toward the chucks at the end of each idle stroke of the rifling tools. This movement is more clearly shown in Fig. 4, the reference letters in this illustration corresponding with those in Fig. 2. It will be noted that a cross-bar is provided to support and guide the rods projecting from the rifling tools.

Indexing the Barrels for Cutting Each Groove

Before each cutting stroke, the barrels are indexed one-fifth revolution by the cam *Q* attached to the slide *F*, Fig. 2. This cam imparts a lateral movement to a cross-bar to which are pivoted four pawls. The pawls engage a ratchet wheel on the chuck spindles and index the spindles. After the spindles have been indexed, they are automatically locked in position by plungers (not shown) entering one of five equally spaced slots around a collar secured to the rear end of the spindles. The plungers are automatically disengaged from the collar before the indexing movement takes place.

* * *

Any machine over ten years old should be considered obsolete until it has been proved to be not guilty of inefficiency.

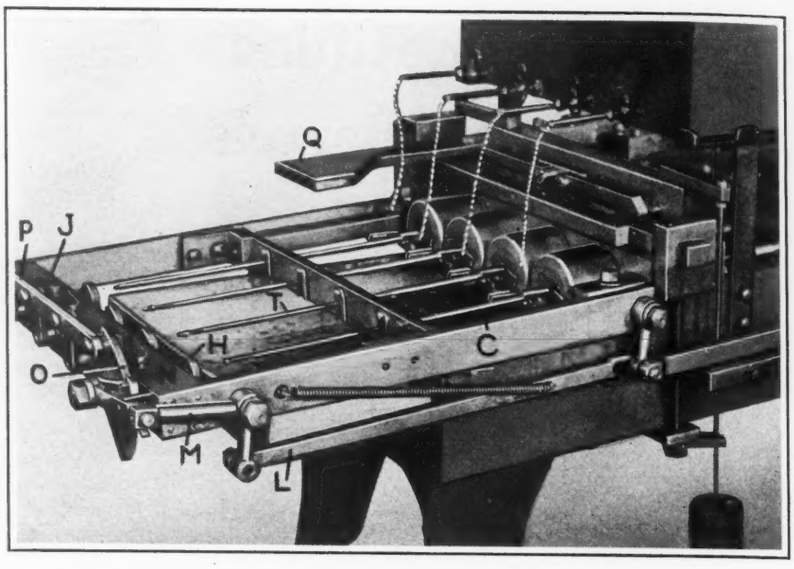


Fig. 4. Close-up View of Machine Illustrated in Figs. 2 and 3, Showing Mechanism for Feeding the Cutters Radially

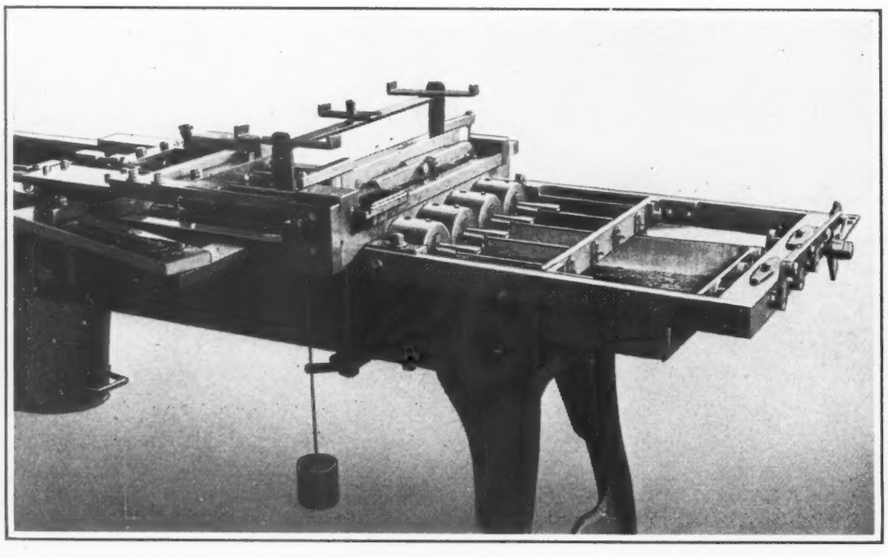
The Hazards of Industry Are Being Reduced

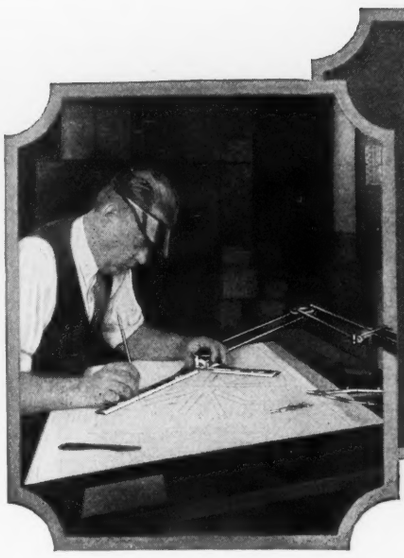
The persistent efforts that have been made to prevent accidents and attain safe working conditions in industry have resulted, in some cases, in greatly reducing the number of deaths and injuries attributable to the hazards of industrial occupation. Records of the safety committee of the General Electric Co. for the last five years reveal that the number of employes who met violent death while at work as a result of industrial accidents was 47, as compared with 155 cases of violent death during the same period among employes who were off duty, according to the records of the company's group life insurance office.

These figures seem to indicate that in this particular plant the hazards of industry are less than those encountered outside. The records also show that during the first four months of the present year, no employe of the company was killed while at work. This is the first time such a record has been established in this plant.

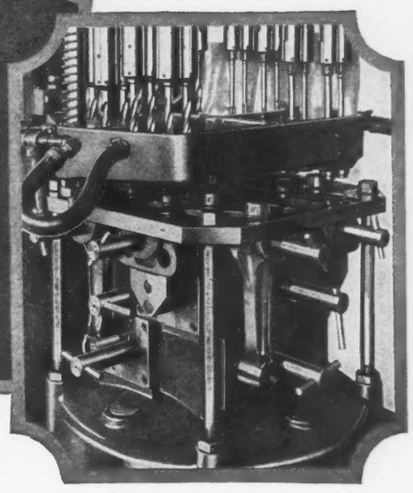
In this connection, it may be mentioned that the best results in accident prevention cannot be secured unless the employes will cooperate with the management by making use of the safety devices provided and never taking unnecessary risks.

Fig. 3. Rear View of Rifling Machine, Showing the Cams for Rotating the Tools and Indexing the Chucks





Design of Tools and Fixtures



Boring Tool for Spherical Hole

By EDWARD HELLER, Cleveland, Ohio

The accompanying illustrations show a simple tool for boring a spherical hole in work handled on a turret lathe. The boring-bar *A* is held in a sliding member *B*, Figs. 1 and 2, which, in turn, is held in the dovetail of the cast-iron holder *C*. This holder has a round shank *D* by means of which it is mounted in the turret of the machine.

In addition to the boring-bar equipment, there is a stationary block *E*, Fig. 1, which is fastened by means of the T-bolts *F* to the cross-slide face. Block *E* carries a profile plate *G* which comes in contact with a follower *H* on the boring-bar holder. The profile plate determines the shape of the hole to be bored. A screw *Q*, threaded to give a tight fit in a tapped hole in sliding member *B*, and passing through the spring stop-plate *R*, prevents the spring *P* from pushing the slide out too far.

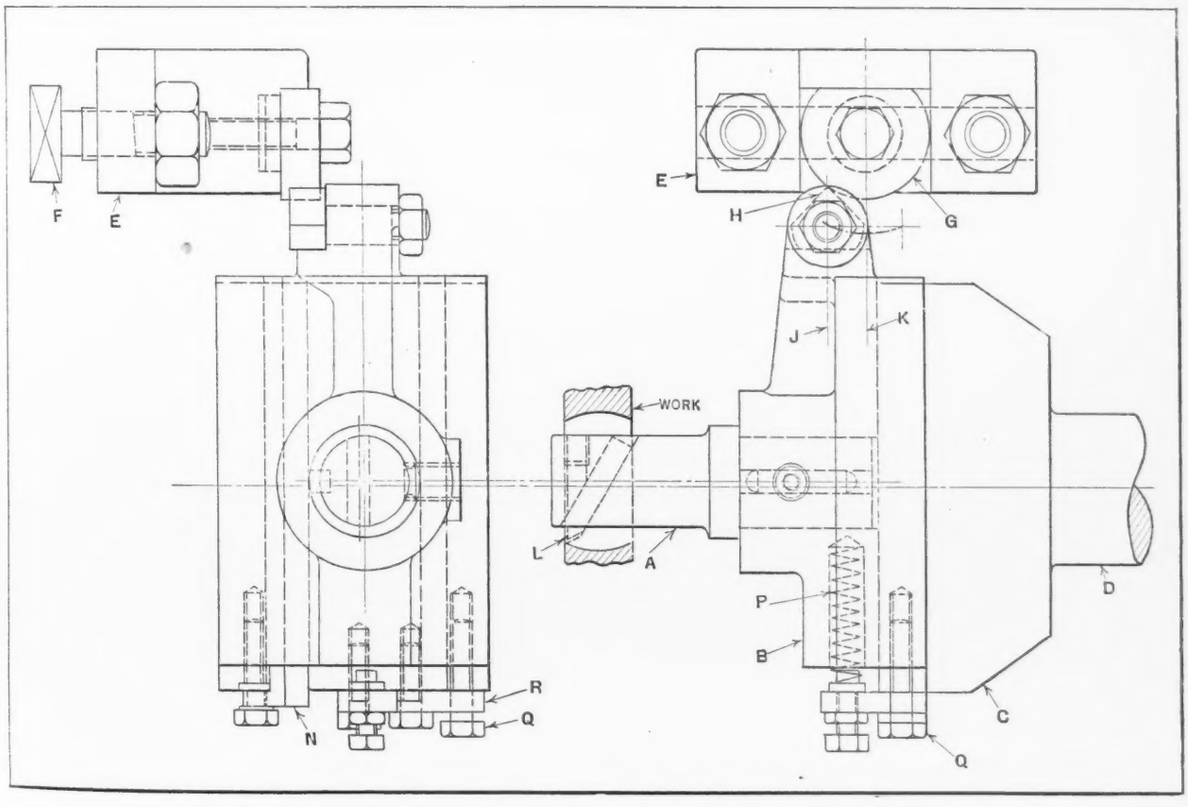


Fig. 1. Special Tool Employed on Turret Lathe for Boring Spherical Hole

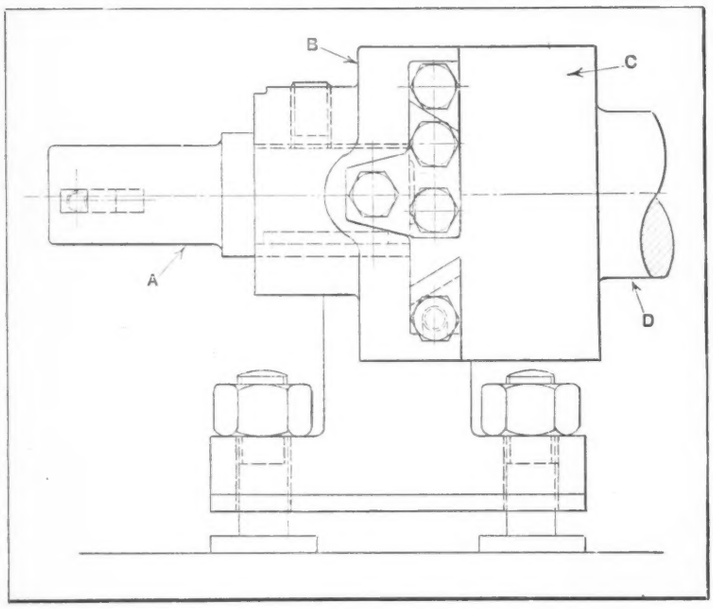


Fig. 2. Front Elevation View of Tool Shown in Fig. 1

In operation, the cross-slide is set so that center lines *J* and *K* coincide when tool bit *L* is in the middle of the work. The cross-slide is then locked tight. Next the cross-feed screw is manipulated until the tool takes a cut in the middle of the work. The turret is then fed in and out, allowing the boring-bar to traverse the entire length of the work. Every time the tool is ready for another cut, the cross-slide is brought a little closer to the front, thus allowing the tool to cut the hole larger and larger.

To obtain the best results, a tool of this kind must be very rugged and the parts must be accurately fitted. The dovetail slide has long bearing surfaces and is provided with a tapered gib *N* to take up any play. The boring-bar *A* is short and stubby, and the profile block *E* is made of machine steel and held down with heavy bolts.

The spring *P* must be heavy enough to keep the follower *H* in contact with the profile plate at all times, and finally, the shape of the point on the follower must be as nearly as possible the same shape as the tool bit; otherwise the shape of the work will not correspond exactly with that of the profile plate *G*. A variety of spherical holes can be bored by providing interchangeable plates *G*.

Piercing, Cutting-Off and Forming Die for Clips

By JOHN G. JERGENS, Cleveland, Ohio

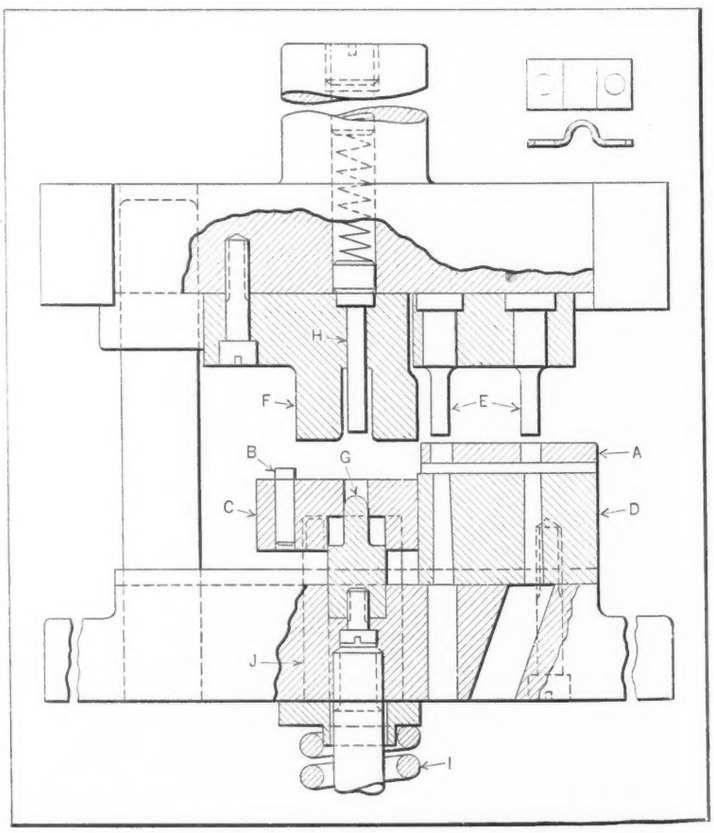
Piercing, cutting-off, and forming operations on steel clips are accomplished in the die shown in the illustration. These clips, one of which may be seen in the upper right-hand corner, are used for fastening gasoline tubes to an automobile chassis. Punch and die-blocks of the pillar-post type are employed to keep the die members in accurate alignment.

In operation, the strip is fed under the stripper plate *A* and against the pin *B* in the pad *C*. This pad is spring-actuated and, in its normal position, is nearly flush with the top of the die *D*. As the punch-block descends, the two holes are pierced by the punches *E;* and at the same time, the strip is cut off to the required length by means of the punch *F*.

Continued downward movement of the ram causes the piece that has been cut off to be carried down between pad *C* and punch *F*, the U-bend being formed as the stationary punch *G* enters the slot in punch *F*. When the ram reaches the bottom of its stroke, pad *C* bottoms solidly on the die-block, and the forming of the clip is completed.

Upon the ascent of the ram, pad *C* strips the clip from punch *G*. If the work should stick in the slot in punch *F*, the ejector-pin *H* will force it out, and it is then ejected from the top of the die by means of compressed air.

Upward movement of pad *C* is effected by the heavy coil spring *I* which forces pins *J* against the



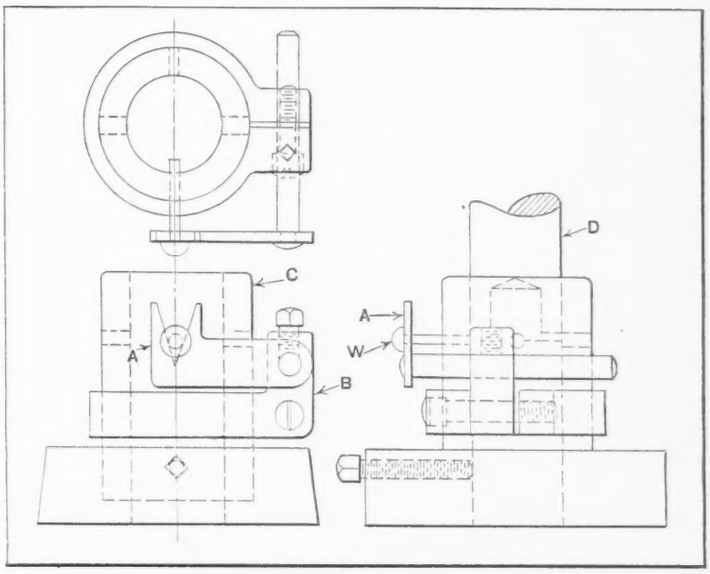
Die for Making Triple Bend and Piercing Two Holes in Clips

bottom of the pad. This vertical movement is limited by means of fillister-head screws (not shown in the illustration) fastened in the die bed, which pass through the pad.

Rivet Shearing Die

By WILLIAM C. BETZ, Master Mechanic
Fafnir Bearing Co., New Britain, Conn.

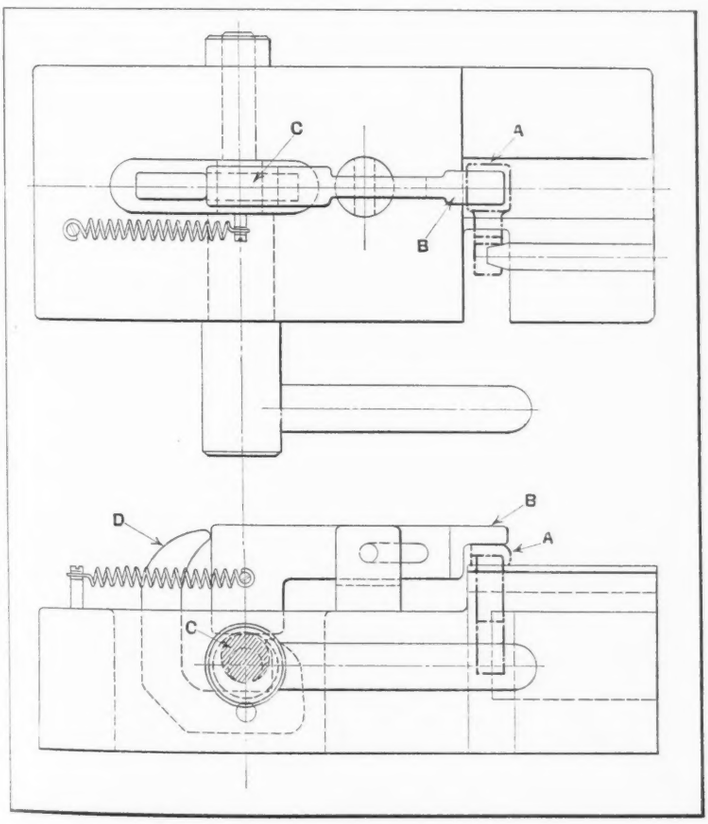
The shearing die shown in the illustration was made for use in cutting off small quantities of rivets and escutcheon pins. The adjustable finger-stop *A* can be set for cutting the pieces to any of the various lengths required. The stop-holder *B* may be turned or adjusted up or down, and also around the die *C* to match any one of the various sizes of holes. The die *C* may also be turned in its base to bring any size hole to the front in order to facilitate operation.



Punch and Die for Cutting off Rivets

The round punch *D* is ground to a close sliding fit in the die, the bore of which is also ground. In shearing a rivet *W*, there is no danger of injuring the die or punch, as the punch has entered and has a secure bearing in the die when the shearing takes place. The ends of the rivets sheared in this die are practically square.

A great many sizes of rivets can be cut off on a die of this type, it only being necessary to drill holes in the die to suit the sizes of the rivets to be cut off. These holes are simply drilled radially through one side or wall of the die. Grooves must be milled or ground on the end of the punch to correspond with the curvature of the rivet bodies. A number of punches may be required to provide as many grooves as there are sizes of holes in the die.



Clamp for Work which Must be Lifted Vertically from Fixture

Eccentrically Operated Clamp

By VERNON WADE, Glasgow, Scotland

The accompanying illustration shows a quick-acting clamp which was designed for a straddle-milling operation in which the work *A* had to be lifted out vertically. For this work, a fairly short forward travel of the clamp *B* before it exerted the downward clamping pressure was sufficient, but the design can be arranged for almost any length of forward travel.

A half turn of the eccentric spindle releases the clamp and the spring pulls it back, thus allowing the work to be lifted vertically. The locking of the clamp is effected by the eccentric *C*, and the forward movement is accomplished by the actuating cam piece *D* which is itself operated by the eccentric.

Facing Bar with Self-Contained Cross-Feed

By HANS SCHMIDT, East Orange, N. J.

In one plant, the open ends of differential casings are machined completely in a Potter & Johnston automatic lathe in one operation, five turret stations being re-

quired to finish each piece. At first, difficulty was experienced in finish-facing the bottom of the large bore at the same setting. This face is shown at *A* in the accompanying illustration, the dimension *B* being required to be held within limits of plus or minus 0.001 inch. Furthermore, this face had to be smooth and square with the center line of the casing.

Formerly, this surface was finished in a separate set-up. To eliminate this extra operation, the tool shown was constructed. This tool is used for finishing only, the roughing cut being taken by another tool in the turret.

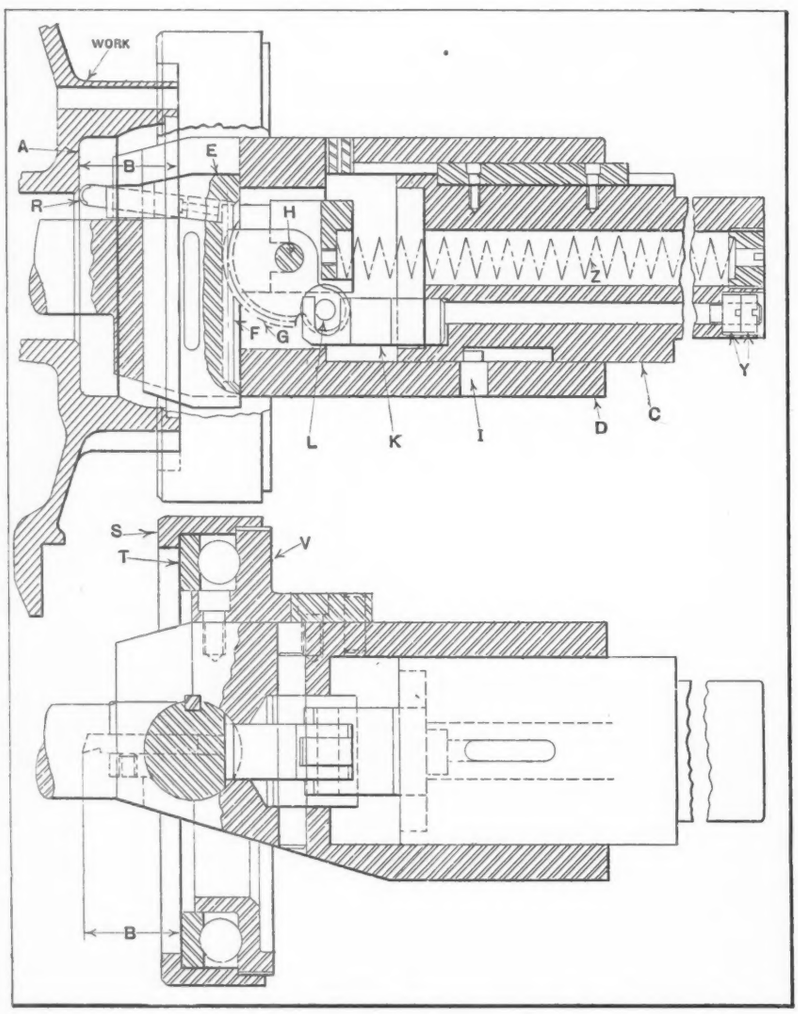
The tool is secured in the turret in the usual manner, the shank being integral with the member *C*. A sleeve *D*, which is a sliding fit on member *C*, carries the cutter *R*. The latter is secured in a block *E* which slides laterally in the sleeve *D*. Rack teeth cut in this block at *F* mesh with the gear sector *G*, which feeds the block laterally when it is oscillated by the yoke *K*. This yoke has an extension which passes through to the end of the shank, and by means of the check-nuts *Y* is adjusted to control the radial movement of the slide *E*.

The gear sector is pivoted on the shaft *H*, which is a drive fit in the sleeve *D*. Rotation of this sleeve on member *C* is prevented by the screw pin *I* engaging an elongated slot in member *C*. In the illustration, the sleeve is shown in its normal position in relation to member *C*, being held thus by means of the spring *Z*.

The distance *B* on the tool is controlled by the stop *S*. This stop consists chiefly of a ring *T* which is free to revolve with the work, thus preventing scoring of the work. It is separated from the spider *V* by a series of balls. The spider is secured to member *D*, and is provided with a retainer which holds both the balls and the stop-ring in place.

In operation, the turret is advanced toward the work, the pilot bar entering a bushing in the machine spindle. When the stop-ring *T* comes in contact with the finished face of the casing, the longitudinal movement of the sleeve *D* ceases, and the point of the tool *R* is at its proper depth. As the turret continues to advance, the yoke *K* engages the roller *L*, thus oscillating the gear sector to which it is pivoted. This action causes the block *E* and the tool *R* to move laterally until the tool has been fed across the face *A*. The turret is then moved away from the work.

It may be mentioned here that the pilot in a tool of this kind should be made of sufficient size to support the cutter in a suitable manner. The use of this tool resulted in a decrease in production time of 4 to 6 minutes on each piece.



Facing Tool to which a Lateral Feed is Imparted by the Longitudinal Movement of the Turret in an Automatic Lathe

Floating Pad for Locating Work in Jig

By WALTER E. TOBOLSKI
South Bend, Ind.

In drilling the hole in the hub of a tailstock handle, the handle is located in the jig at three points. As shown in the illustration, the ball end at the right is located in the bore of a bushing, and the ball at the left in the countersunk end of another bushing. To locate the screw boss level, the floating pad *A* was devised; this pad is locked in position by the lever *B*.

In order to lower the pad out of engagement with the work while loading the jig, the lever *C* is swung to the left or right. The pad, as shown in detail at the right, is spring-actuated and has an angular section milled at one side against which the locking screw *D* acts. An eccentric projection on the shaft *E* engages the

shoulder F on the pad, so that the latter is lowered when lever C is swung from the position shown.

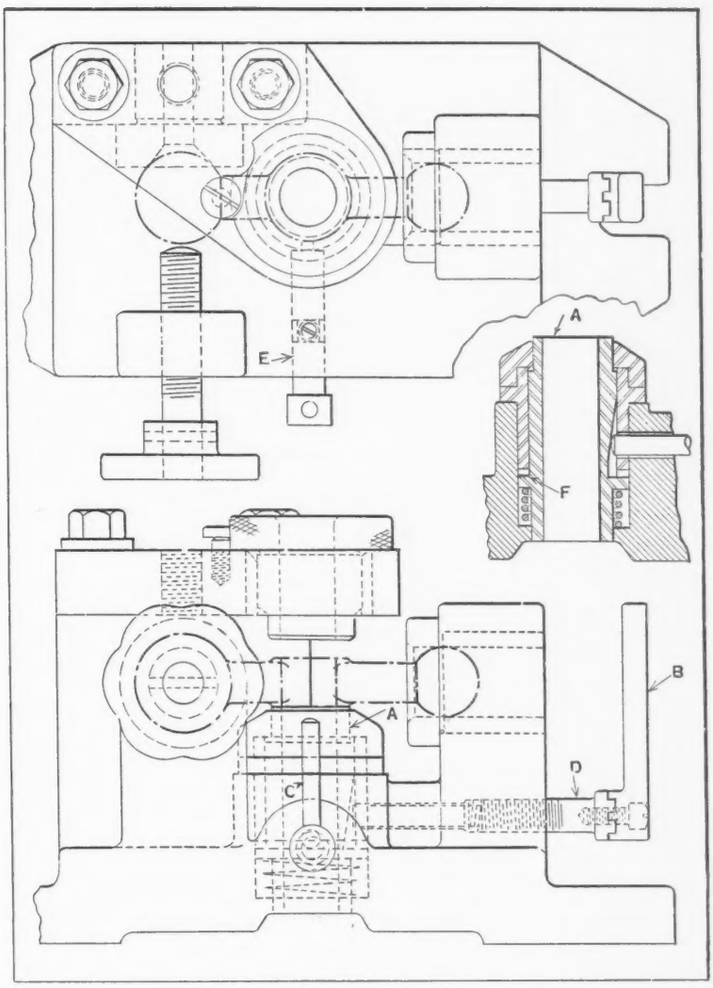
In operation, the work is located in the jig by means of the two bushings mentioned, and lever C is swung up to the position indicated. This releases pad A and allows it to rise and square up the work, after which screw D is tightened against the pad. This pad also serves as a support for the work during the drilling operation, a clearance hole being provided through it to allow the drill and the chips to pass through.

Drill Jig Made of Welded Steel Plate

By EDWARD HELLER, Cleveland, Ohio

The drill jig here illustrated (see the next page) is one of two slightly different jigs that were designed and made in less than six days for use in drilling the aluminum casting C indicated by heavy dot-and-dash lines. As only a limited number of castings were to be drilled, the jigs had to be inexpensive. They also had to be light enough to enable one man to handle them conveniently and roll them into any one of the five drilling positions.

There are four holes D in the top of the casting, three holes E in the bottom, two holes F in the lugs on the sides about half way between the top and bottom, and four holes G in two sets of ears located 60 degrees from the center line Z–Z. It was impossible to make the jigs with cast-iron bodies, on account of the time available and the cost. Instead, the welded plate and bar construction illustrated was employed, which not only gave an excellent job at a reasonable cost, but also enabled the work to be completed in the required time.



Jig in which Work is Leveled by Means of a Floating or Spring-actuated Pad

About three hours were spent in designing the jig and making a drawing to show approximately what material would be required. The plate H, the center ring J, the top ring K, and the top jig plate L were next laid out full size. These full-size layouts were sent to the steel warehouse, where they were used as transfer templets on boiler plate, from which the pieces for the jig were cut with a torch. These pieces were delivered to the shop the same day the job was commenced, and two big lathes were started on the machining work. In the meantime, the designer had an opportunity to fill in the details on the drawing.

The three plates, H, J, and K were held together by four vertical machine-steel bars M, which were welded in place. The thin ring N serves to locate the bottom of the work. The center ring carries two lugs P for the bushings used in drilling holes F, and the top ring carries two lugs for the bushings employed in drilling holes G. The top jig plate L has four buttons Q driven into place from the bottom. The heads of these buttons were turned to fit the inside of the casting. Three rectangular blocks R were also fastened to the same face for locating the sides of the lugs S.

The bottom jig plate T was suspended by three bars U from the upper plate, and the whole jig plate assembly was located on two dowels W and fastened together by means of the screws and the knurled nuts X. The pins W, only one of which is shown in the illustration, are of different diameters, so that the plate T can be set on the lower member in one way only. Owing to the overhang of the lugs G, two blocks Y were welded to the corners of the top ring K to provide support directly under the drill. Only two parts of the jig, the ring N and locators R, were fastened with screws and dowels, all other parts being welded.

The various details were set up on surface- and angle-plates and held together with clamps while being tack-welded with a torch. The jig was then released and allowed to cool off. Any distortion resulting from the heating was then corrected, and the jig again clamped rigidly in place for finish-

welding. After completing the welding, the jig was left to cool for a few hours in the clamped position. When finally released, it was found that very little truing up had to be done. The locators were next assembled to the top and bottom members, and the whole jig set up on the jig borer for boring the bushing holes. Pressing the bushings into place completed the jigs.

Before the body of the jig was welded together, holes were drilled in the rings *H* and *K* and sections of the boiler plate cut out, as shown at *I*, to reduce the weight. The drill jigs thus made, although not perfectly adapted for production work, served their purpose satisfactorily and enabled the aluminum castings to be drilled and delivered on time. The two dimensions shown in the illustration indicate the size of the casting drilled.

* * *

On a certain press job that ran almost continuously the stock was fed by a roll, and a soluble oil coolant was allowed to drip on the work, which was ejected from the die by a jet of compressed air. By installing a coolant pump and means for collecting the overflow, it was possible to dispense with the air ejector, the cooling stream being sufficient to wash the parts off the die when the press was inclined.

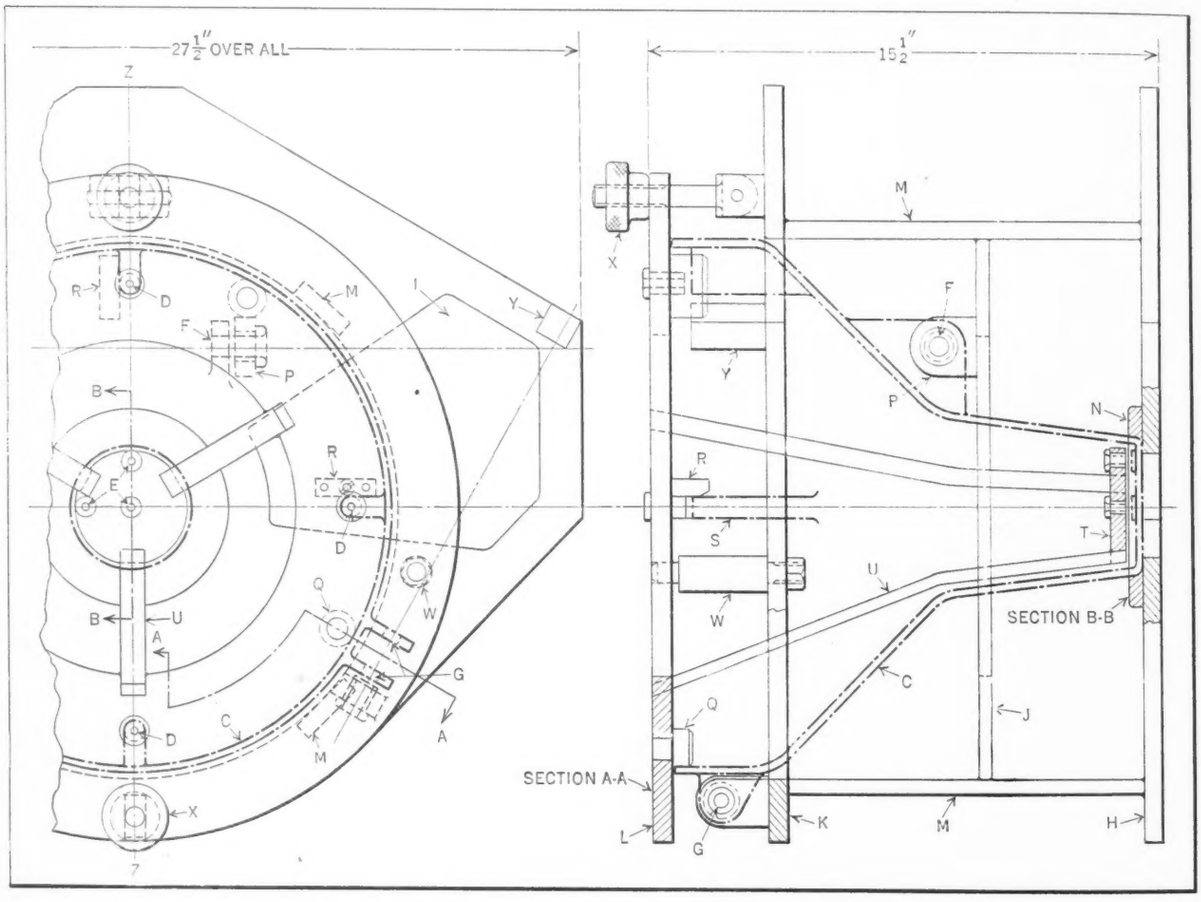
How the Drafting-Room Can Aid Production

By ALFRED LAYZELL, East Paterson, N. J.

There are various ways in which the drafting-room can help to speed up production and reduce scrap. Most designers are likely to center their efforts on the successful working of the machine they are designing and give but little thought to the rapid production of the various parts. The draftsman and designer should endeavor to simplify drawings as much as possible, so that they will be readily understood. In showing sections, all unnecessary lines behind the section should be avoided, as they tend to confuse. Where there is any chance of misunderstanding, arrows, preferably in red, and notes should be included.

Production can be greatly aided by avoiding unreasonable limits. Avoid close tolerances on parts that simply "fit in the air." If liberal allowances are made when accuracy is not essential, the machine shop will take greater care when close limits are marked.

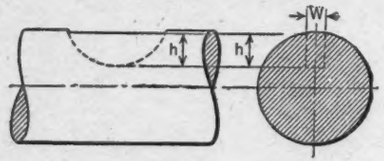
The chief draftsman and the chief inspector should hold regular conferences, and the latter should report on all scrap, so that if the drafting-room can aid in reducing the amount of spoiled work, it will be given an opportunity to do so.



Jig of Welded Steel Construction for Drilling Aluminum Casting

WOODRUFF KEYSLOT DIMENSIONS

Approved by American Standards Association, December, 1930



All dimensions in inches

Key Number*	Nominal Key Size A × B	Keyslot			
		Width W		Depth h	
		Max.	Min.	Max.	Min.
204	1/16 x 1/2	0.0630	0.0615	0.1718	0.1668
304	3/32 x 1/2	0.0943	0.0928	0.1561	0.1511
305	3/32 x 5/8	0.0943	0.0928	0.2031	0.1981
404	1/8 x 1/2	0.1255	0.1240	0.1405	0.1355
405	1/8 x 5/8	0.1255	0.1240	0.1875	0.1825
406	1/8 x 3/4	0.1255	0.1240	0.2505	0.2455
505	5/32 x 5/8	0.1568	0.1553	0.1719	0.1669
506	5/32 x 3/4	0.1568	0.1553	0.2349	0.2299
507	5/32 x 7/8	0.1568	0.1553	0.2969	0.2919
606	3/16 x 3/4	0.1880	0.1863	0.2193	0.2143
607	3/16 x 7/8	0.1880	0.1863	0.2813	0.2763
608	3/16 x 1	0.1880	0.1863	0.3443	0.3393
609	3/16 x 1 1/8	0.1880	0.1863	0.3903	0.3853
807	1/4 x 7/8	0.2505	0.2487	0.2500	0.2450
808	1/4 x 1	0.2505	0.2487	0.3130	0.3080
809	1/4 x 1 1/8	0.2505	0.2487	0.3590	0.3540
810	1/4 x 1 1/4	0.2505	0.2487	0.4220	0.4170
811	1/4 x 1 3/8	0.2505	0.2487	0.4690	0.4640
812	1/4 x 1 1/2	0.2505	0.2487	0.5160	0.5110
1008	5/16 x 1	0.3130	0.3111	0.2818	0.2768
1009	5/16 x 1 1/8	0.3130	0.3111	0.3278	0.3228
1010	5/16 x 1 1/4	0.3130	0.3111	0.3908	0.3858
1011	5/16 x 1 3/8	0.3130	0.3111	0.4378	0.4328
1012	5/16 x 1 1/2	0.3130	0.3111	0.4848	0.4798
1210	3/8 x 1 1/4	0.3755	0.3735	0.3595	0.3545
1211	3/8 x 1 3/8	0.3755	0.3735	0.4065	0.4015
1212	3/8 x 1 1/2	0.3755	0.3735	0.4535	0.4485

*Key numbers indicate the nominal key dimensions. The last two digits give the nominal diameter *B* in eighths of an inch, and the digits preceding the last two give the nominal width *A* in thirty-seconds of an inch. Thus, 204 indicates a key 2/32 × 4/8 or 1/16 × 1/2 inch; 1210 indicates a key 12/32 × 10/8 or 3/8 × 1 1/4 inches.

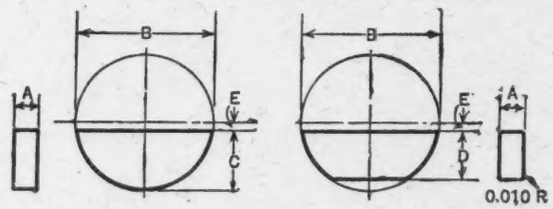
The maximum and minimum limits for the key width given in Data Sheet No. 207 are such that, when the keys are assembled with the keyslot whose width and tolerances are given in this Data Sheet, the assembly can be made without distortion of the shaft or individual fitting when the maximum key is inserted in the minimum keyslot, and also without shake when the minimum key is inserted in the maximum keyslot.

Such interchangeability facilitates mass production and assembling. For more particular work, the specified fit may be obtained by gaging the finished keyslot and selecting by measurement the key required. Breaking the key corners with a 0.010-inch radius is optional, but sharp edges should be removed from all finished keys.

The depth *h* of the keyslot is measured from the sharp edge of the slot. The depth to which the cutter is fed into the shaft varies with the shaft diameter. The amount that the key will extend from the shaft may be determined by subtracting the keyslot depth *h* from the height *C* of the key given in Data Sheet No. 207.

WOODRUFF KEY DIMENSIONS

Approved by American Standards Association, December, 1930



All dimensions in inches

Key Number*	Nominal Key Size A × B	Width of Key A		Diameter of Key B		Height of Key				Distance below Center† E
						C		D		
		Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	
204	1/16 x 1/2	0.0635	0.0625	0.500	0.490	0.203	0.198	0.194	0.188	3/64
304	3/32 x 1/2	0.0948	0.0938	0.500	0.490	0.203	0.198	0.194	0.188	3/64
305	3/32 x 5/8	0.0948	0.0938	0.625	0.615	0.250	0.245	0.240	0.234	1/16
404	1/8 x 1/2	0.1260	0.1250	0.500	0.490	0.203	0.198	0.194	0.188	3/64
405	1/8 x 5/8	0.1260	0.1250	0.625	0.615	0.250	0.245	0.240	0.234	1/16
406	1/8 x 3/4	0.1260	0.1250	0.750	0.740	0.313	0.308	0.303	0.297	1/16
505	5/32 x 5/8	0.1573	0.1563	0.625	0.615	0.250	0.245	0.240	0.234	1/16
506	5/32 x 3/4	0.1573	0.1563	0.750	0.740	0.313	0.308	0.303	0.297	1/16
507	5/32 x 7/8	0.1573	0.1563	0.875	0.865	0.375	0.370	0.365	0.359	1/16
606	3/16 x 3/4	0.1885	0.1875	0.750	0.740	0.313	0.308	0.303	0.297	1/16
607	3/16 x 7/8	0.1885	0.1875	0.875	0.865	0.375	0.370	0.365	0.359	1/16
608	3/16 x 1	0.1885	0.1875	1.000	0.990	0.438	0.433	0.428	0.422	1/16
609	3/16 x 1 1/8	0.1885	0.1875	1.125	1.115	0.484	0.479	0.475	0.469	5/64
807	1/4 x 7/8	0.2510	0.2500	0.875	0.865	0.375	0.370	0.365	0.359	1/16
808	1/4 x 1	0.2510	0.2500	1.000	0.990	0.438	0.433	0.428	0.422	1/16
809	1/4 x 1 1/8	0.2510	0.2500	1.125	1.115	0.484	0.479	0.475	0.469	5/64
810	1/4 x 1 1/4	0.2510	0.2500	1.250	1.240	0.547	0.542	0.537	0.531	5/64
811	1/4 x 1 3/8	0.2510	0.2500	1.375	1.365	0.594	0.589	0.584	0.578	3/32
812	1/4 x 1 1/2	0.2510	0.2500	1.500	1.490	0.641	0.636	0.631	0.625	7/64
1008	5/16 x 1	0.3135	0.3125	1.000	0.990	0.438	0.433	0.428	0.422	1/16
1009	5/16 x 1 1/8	0.3135	0.3125	1.125	1.115	0.484	0.479	0.475	0.469	5/64
1010	5/16 x 1 1/4	0.3135	0.3125	1.250	1.240	0.547	0.542	0.537	0.531	5/64
1011	5/16 x 1 3/8	0.3135	0.3125	1.375	1.365	0.594	0.589	0.584	0.578	3/32
1012	5/16 x 1 1/2	0.3135	0.3125	1.500	1.490	0.641	0.636	0.631	0.625	7/64
1210	3/8 x 1 1/4	0.3760	0.3750	1.250	1.240	0.547	0.542	0.537	0.531	5/64
1211	3/8 x 1 3/8	0.3760	0.3750	1.375	1.365	0.594	0.589	0.584	0.578	3/32
1212	3/8 x 1 1/2	0.3760	0.3750	1.500	1.490	0.641	0.636	0.631	0.625	7/64

*Key numbers indicate the nominal key dimensions. The last two digits give the nominal diameter *B* in eighths of an inch, and the digits preceding the last two give the nominal width *A* in thirty-seconds of an inch. Thus, 204 indicates a key 2/32 × 4/8 or 1/16 × 1/2 inch; 1210 indicates a key 12/32 × 10/8 or 3/8 × 1 1/4 inches.

†This dimension given to facilitate lay-out in drafting-room.

The Shop Executive and His Problems

Superintendents and Foremen are Invited to Exchange Ideas on Problems of Shop Management and Employe Relations

ONE of our employes submitted the following idea through our suggestion system: He proposed that after an idea had been either adopted or rejected, a good drawing showing the suggestion be made in the drafting-room and posted on the shop bulletin board, together with the comments of the reviewing committee. This would stimulate further thought among other employes. It might also result in some of the rejected ideas being studied by the rest of the organization and improved so that they might be useful. The ideas would be posted on the board for a month.

It is impossible to say yet just how valuable this method will prove to be. Up to the present time, however, it has nearly doubled the number of acceptable suggestions and saved several hundred dollars a week. After all, the scheme is similar to that of publishing an idea in the technical press, so that others can comment on it and suggest improvements.

CHARLES H. WILLEY

Employes' Suggestions for Changing or Correcting Orders

The writer heartily agrees with the sentiments expressed in the article in the Shop Executive section of June MACHINERY that approves of the employe's right to voice his opinion about the justice or efficiency of an order. Some men, however, would take advantage of such privileges or rights; and, if permitted, would waste their time talking and arguing with their foremen, which, of course, would not be conducive to good management or production. It is interesting to note that the plan suggested in the article referred to is now in operation in a certain plant.

In this plant a notice was posted on all the bulletin boards to the effect that as it was possible for the engineers, draftsmen, production men, and foremen to make mistakes, the foremen would be glad to receive any suggestions concerning necessary or desirable changes in the orders issued. The method used to prevent the men from spending too much of their time trying to get things done in a different way is simply the old method of applying good judgment—that is, the foreman listens attentively to any suggestion and makes a decision on it immediately. If in his opinion it is not worth using, that ends the matter and there is no further talk. If, on the other hand, the suggestion appears worthwhile, it is immediately followed up.

To some it may seem that this gives the foreman too much power or "say" in the matter, but after all, this practice is simply a sensible application of the old principle of good management. The foremen in this shop are appointed for their ability, good judgment, and willingness to listen to anything concerning the welfare of the company. If concerns are careful in the selection of their supervisory force, they can readily adopt the practice described with a saving in time and money. The manager of this plant reports that, since the inception of the plan of inviting comment, the company has been able to rectify many mistakes, and as a result has saved thousands of dollars. Such a plan could be profitably adopted in many plants.

CHARLES R. WHITEHOUSE

Homemade Repair Parts and Cutting Compounds

There are times when a machine is in immediate need of a simple repair part. It seems very easy to make it, and the superintendent or foreman says to himself, "I can make that in an hour and save $5"—or something to that effect. Or he may hire a neighboring jobbing shop to make a repair part for him at a "low figure."

But the results are not always satisfactory. The chances are that the part will not fit properly. As a result, the machine on which it is used gives less efficient service, its usefulness is impaired, and the reputation of the manufacturer on whose machine a homemade repair part is used is often seriously injured.

Many mechanics think that they can easily replace such simple things as brass bushings, for example; but generally the replacement bushing, if homemade, is not like the one originally furnished on the machine. The making of finished bronze bearings and brass bushings is a job in which manufacturers with many years of experience and skill have specialized.

These remarks apply equally well to concerns who attempt to make their own cutting compounds. It seems quite easy to prepare a compound, and some firms think that they are saving considerable money in so doing. As a rule, however, money is not saved that way. The reverse is usually the case—money is lost because the homemade cutting compound is generally inferior to the compounds that are manufactured by specialists.

W. F. SCHAPHORST

What We Have Learned About Tungsten Carbide

Fundamental Rules and Instructions for Applying Tungsten-Carbide Tools, Based on Practical Experience—Second of Two Articles

By FRANK W. CURTIS, Research Engineer
Kearney & Trecker Corporation, Milwaukee, Wis.

TEN fundamental rules for the application of tungsten-carbide tools were formulated in the first article on this subject, which appeared in July MACHINERY, page 867. Five of these rules were discussed in that article. In the present article, the other five rules will be considered. The ten rules are:

1. Apply only on suitable operations.
2. Use only on machines worthy of application.
3. Provide rigidly constructed fixtures.
4. Increase the size of the tool.
5. Support tool solidly.
6. Use correct feeds and speeds.
7. Do not stop tools in cut.
8. Grind tools accurately and correctly.
9. Resharpen tools regularly.
10. Keep extra tools on hand.

The use of correct feeds and speeds is highly essential with any type of cutting tool. Naturally, if the tool operates slowly, it is likely to wear excessively. On the other hand, if it operates at too great a speed, the cutting edges will burn or wear rapidly. It is merely a case of finding the correct speed and feed combination for a given cut, which, of course, cannot be determined exactly, because there are too many factors to consider. In other words, it would be wrong to assume that three or four times the speed used for a high-speed tool can be employed for tungsten carbide. This rule would be satisfactory in some cases, but unsatisfactory in others.

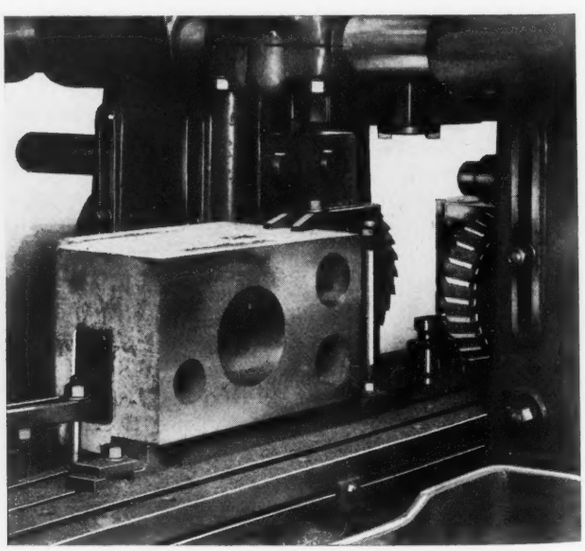
Tests should be conducted to determine the correct speeds and feeds, based upon the grade of finish desired as well as the life of the tool between grinds. For ordinary operations, however, it is safe to increase the speed from two to four times that used with high-speed steel, and decrease slightly the feed per tooth, or per revolution, depending upon the nature of the cut. On this basis, the feed per minute will be increased considerably.

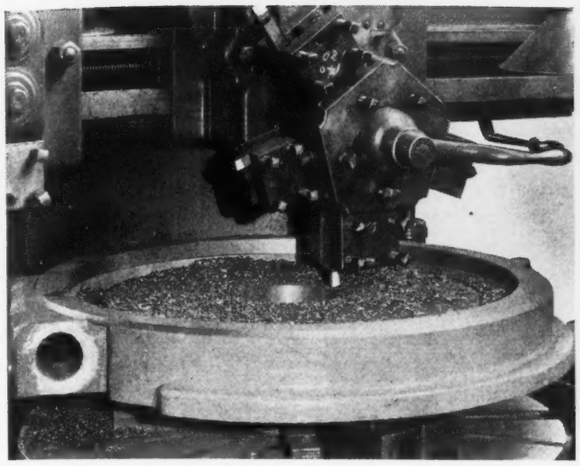
Continuous Cutting is Desirable

Inasmuch as tungsten-carbide tools will not stand sudden shocks, it is strongly recommended that at no time should the tool be stopped in the cut; that is, the spindle should not be stopped while the feed is engaged. For example, it may be possible to take off a large amount of metal with a tungsten-carbide

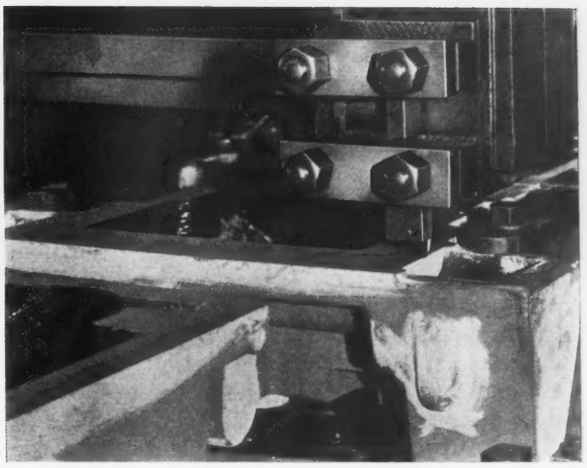
Facing a Casting with Tungsten Carbide where the Cut is Interrupted; Cutting Speed, 260 Feet per Minute; Roughing Cut, 1/8 to 3/16 Inch Deep; Finishing Cut, 1/64 Inch Deep; Feed, 0.015 Inch

Milling Semi-steel Spindle Blocks, Using Two 12-inch Tungsten-carbide Cutters Operating at a Speed of 275 Feet per Minute; Table Feed, 14 Inches per Minute; Cuts from 3/16 to 3/8 Inch Deep





Set-up for Rough-facing Semi-steel with Tantalum-carbide (Ramet) Tool, Using a Speed of 225 Feet per Minute and a Feed of 0.028 Inch, which Resulted in a Reduction of 46 Per Cent in the Machining Time



Planing Semi-steel Casting with Tungsten-carbide Tool. Advantages are Long Periods between Grinds and the Smooth Surface Obtainable without Cutting entirely through the Hard Outer Layer

tool in a lathe, but if the spindle should stop suddenly with the tool in the cut, the tool would be subjected to an excessive strain. In such cases, the tip usually cracks, flakes, or breaks in two, even though the tool is backed off with care. This damage is done just before the spindle comes to a full stop.

Correct Tool Grinding is Essential

Accurate tool grinding is important with any type of cutting metal, and is equally important, if not more so, with tungsten carbide. The proper angles should be determined for a given application, and these angles should be adhered to for all future uses unless new developments make others advisable. In other words, if the lathe tool works better with a 6-degree top side rake, a 5-degree clearance on the front nose, and 4 degrees on the side, it would be a mistake to change these angles, either one way or another, largely because the cutting characteristics of tungsten carbide would be affected. The use of gages and templets is strongly recommended, because success depends largely on proper grinding.

Tools Should be Sharpened Regularly

In connection with grinding, it is always well to remember that there is a limit to the amount of work that can be done with a tool between grinds. Although tungsten carbide is extremely hard and in most cases has a very long life, it should be remembered that greater economy can be obtained if the tool is ground at regular intervals. First, a tool that has become dull increases the power consumption. Second, a tool operating while dull is subjected to excessive cutting pressure which, in many cases, has a tendency to cause cracks or complete breakage.

Very often it is possible to increase the life of the tool by frequent honing between grinds. However, such a procedure will not keep the tool sharp indefinitely, and it is obvious that a new, keen cutting edge must be formed. To do this requires the proper type of wheel and correct grinding equipment, handled by an operator who is trained to grind tungsten carbide. Always check the angles of the tool before it is applied. If this is done, you will have a better chance of obtaining the full value of tungsten carbide.

Duplicate Tools Should be Kept in Reserve

There is probably nothing more discouraging than to change an operation to conform with the cutting characteristics of tungsten carbide and then have to change back to old methods just because no extra tools are available. It is just as though you were assembling automobiles and found that you did not have rear axles or some other major unit.

Always carry on hand a sufficient number of tools to supply your immediate demands. If a certain turning operation requires five individual tools, for example, it would be well to order these tools in sets of six or twelve, and then reorder when the supply is reduced to three sets. This would insure having sufficient quantities on hand until a new order could be filled by the tool manufacturer.

Recording Results

For many reasons, every effort should be made to keep an accurate account of all performance information for future reference. Usually, this information can be distributed to advantage throughout the plant. It would be well to select some individual as a tool-application man, whose duty it would be to conduct all tests and trials and to record miscellaneous data for reference purposes. This

procedure has been very beneficial in practically all shops where it has been followed and will, of course, prove valuable in all shops where the full advantages of tungsten carbide are desired.

Advantages of Tungsten Carbide

Tungsten carbide has many advantages, but it is well to realize that a great many changes will have to be made before the full benefits can be derived from this material. It is safe to assume that drastic changes will have to be made in present manufacturing methods, and in products as well. Tougher, harder metals can be machined with tungsten carbide, which means that thinner castings can be designed with a strength equal to or exceeding that of the castings that are now used for the same purpose. In such cases, the savings in weight will have an effect on the material cost and selling prices of mechanical products.

Another outstanding advantage of tungsten carbide is the fact that it will cut through scale as well as through the inner section of the casting. This means that less allowance need be made for finishing purposes, which naturally will result in less material per casting.

For example, a surface 6 by 8 inches, that is to be face-milled with a high-speed steel milling cutter would have an allowance of approximately 3/16 inch. The amount of metal removed would be equivalent to 9 cubic inches. With a tungsten-carbide milling cutter, this allowance could be safely reduced to 3/32 inch, which would, of course, necessitate the removal of only 4 1/2 cubic inches. The saving on the surface, at 0.26 pound per cubic inch, would be equivalent to 1.17 pounds. This is an attractive saving when large quantities are produced. In addition, the power consumption would be reduced almost 50 per cent. Besides these savings, it is possible to increase the feed of the machine to obtain a proportionate increase in production.

Higher Speeds Permit Finishing in One Cut

Because of the high peripheral speeds that can be used with tungsten carbide, it is often possible to produce a satisfactory finish in one cut, where two are ordinarily required. This does not apply to all cases, but it has outstanding possibilities that should be investigated in all plants engaged in quantity production. This feature, combined with the saving in metal through less machining allowance, shows what can be expected in the future.

Few people realize what tungsten carbide means to industry. True enough, its cutting qualities are appreciated, as larger outputs can be maintained. However, the changes that are going to be made in our methods in the near future, together with the introduction of machines designed on entirely new principles, will probably mean a great deal more than the savings that are now being effected.

Our future machines will have a great deal more strength and higher speeds than have ever been required in the past. Spindle drives and gearing combinations will have to be made stronger than they are at present. The present type of cutting tools will naturally change materially, because it is quite apparent that new tool-holders are urgently needed, especially in lathes. Perhaps the best indication of what tungsten carbide means to industry is the fact that it has already made obsolete more than $100,000,000 worth of machinery in the automotive industry alone.

Conclusions Drawn from Present Practice

Upon analyzing the work being done in our plant with tungsten-carbide tools, the following conclusions were reached:

1. Higher speeds and faster feeds are outstanding among the advantages obtained by the use of tungsten-carbide tools.

2. Greater accuracy is obtained with the increased speeds used with tungsten carbide, especially when a slight reduction is made in the feed per revolution. The higher speeds, of course, give a considerable increase in feed per minute, and at the same time permit a reduction in the feed per revolution. We find that parts can be machined more accurately with tungsten carbide than with other tools.

3. Longer life between grinds is one of the outstanding advantages of tungsten carbide, due largely to the extreme hardness of this metal.

4. The better, smoother finish obtained with tungsten carbide is attributed to the same qualities that give greater accuracy.

5. Practically no heating of the work is observed; the faster the material is machined, the less likelihood there is of heat being generated in the work. Practically all the heat appears to be dissipated through the chips.

6. Minimum distortion occurs in the work, due to the generation of less heat in the work itself at the high cutting speeds employed. For this reason, frail parts can be machined much faster than has heretofore been possible with tools that operate at slower speeds.

7. The chipping of corners is avoided by the fast cutting speeds of tungsten carbide. We find the chipping of corners on cast-iron parts, for example, has been practically eliminated.

8. A reduction in the depth of cut required in finishing cast-iron parts is possible, as the scale can be readily cut by the tungsten carbide. This gives us three sources for savings: First, less material is required; second, the amount of power required per square inch of surface machined is reduced; third, the feed per minute is increased, giving us greater production.

9. Finishing work in one cut instead of in two is an important advantage. This advantage is due to the remarkable cutting qualities of tungsten carbide.

10. Materials that were previously considered too hard to be machined are now machined satisfactorily with tungsten carbide. Already tantalum-carbide tools are machining manganese steel successfully.

Notes and Comment on Engineering Topics

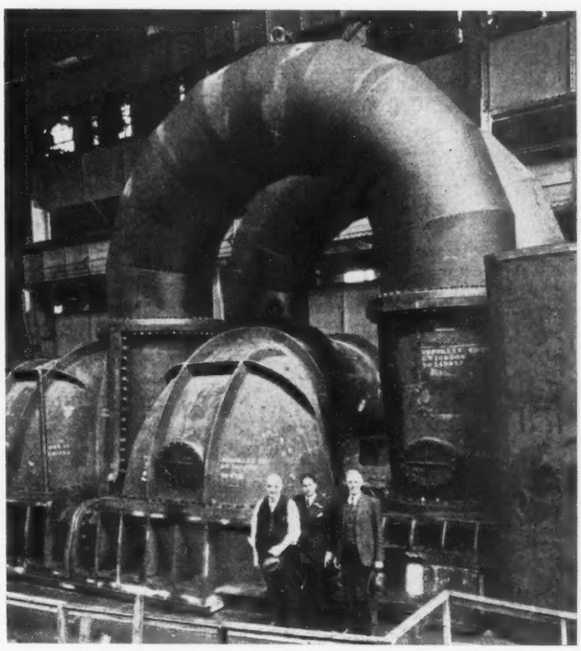
There are more than 8000 airplanes in use in the United States. In 1901 there were approximately that number of automobiles in use in this country. Today, we have 25,000,000 cars and trucks on our roads. How many airplanes will we have thirty years hence?

In an item published in *The Locomotive*, it is mentioned that the best long-period efficiency record for steam stations in 1930 was a kilowatt-hour of electrical output for 12,455 B.T.U. A mercury boiler installed in a power plant in Hartford, Conn., averaged a kilowatt-hour for 10,310 B.T.U. over a period of ten months. It is reasonable to assume, however, that the plant investment for the mercury boiler installation is greater than that for a regular steam boiler installation, so that the mercury boiler equipment doubtless carries a heavier overhead.

The "rail-fissure detector car," commonly known as the Sperry detector car, is one of the latest devices used by the railroads to insure safer and more efficient transportation. The device is the invention of the late Dr. Elmer A. Sperry, a past president of the American Society of Mechanical Engineers.

Moving along at the rate of six miles per hour, the Sperry detector car will not only locate invisible flaws in the rails over which it passes, but will also place a paint mark on the rail wherever there is a flaw. It will make an ink record of the defect and will indicate whether the defect is large or small. The value of the detector car lies in its ability to locate hidden rail defects that are not visible from the outside and that are likely to become more serious when the rail is subjected to continued traffic. One of these detector cars was placed in service in November, 1928, and has not been idle a single day since, except for occasional overhauling and inspection and for shipping from one road to another. In about two years' time it has tested 6500 miles of track and located 1682 defective rails.

High-strength cast iron ranges in tensile strength from 38,000 to 50,000 pounds per square inch. This strength is obtained by alloying cast iron with nickel or nickel and chromium. The carbon content of this high-strength cast iron varies from 2.7 to 3.15 per cent. A Brinell hardness of 240 is obtainable. This alloy cast iron also has a greater resistance to wear, although its machining qualities are practically the same as those of ordinary gray iron. The high-strength cast iron is particularly suitable for medium and heavy castings when a combination of strength and resistance to wear is essential. Practically any foundry can make iron of this kind if a few essential precautions are taken.



A 160,000-kilowatt Steam Turbine—One of Two Being Built for the Brooklyn Edison Co., in Final Stages of Assembly at the Schenectady Works of the General Electric Co.

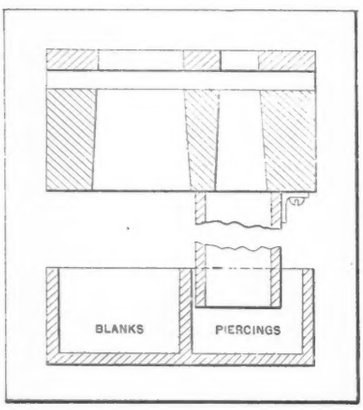
Buffet, gas stove, refrigerator, overstuffed furniture, pullman beds, radio, telephone service between passengers and pilot, and hot and cold running water are features of a new Boeing trimotor plane. This plane is powered with three 525-horsepower Hornet engines. It has a high speed of 145 miles per hour, and cruises at 120 miles per hour. The pilot's compartment has ninety controls, instruments, and other aids to navigation. There is special night flying equipment and radio-telephone, enabling pilots to talk with ground stations or with other planes in flight. The wing span is 80 feet, and the length 55 feet. When fully loaded, the plane weighs 9 tons.

Ideas for the Shop and Drafting-Room

Time- and Labor-Saving Devices and Methods that Have been Found Useful by Men Engaged in Machine Design and Shop Work

Separating Blanks and Piercings

Usually, in a blanking and piercing die, especially where the holes are close together, both blanks and piercings pass through the die and drop into one receptacle. This makes it necessary to separate the piercings and the blanks afterward. To avoid this, the writer employs the simple method shown in the illustration. The ends of two pipes or tubes are attached to the under part of the die and cover the clearance holes. These pipes lead to two separate compartments in a special container, thus delivering the blanks and piercings to their respective compartments. When several holes are pierced, a pipe large enough to cover all the piercing holes in the die may be employed; or when the piercing holes are some distance apart, separate pipes may be used.



Use of Tubes for Separating Blanks and Piercings after They Pass through the Die

Philadelphia, Pa. C. KUGLER

Using Band Saws in the Tool-Room

We have been using a band saw for general tool-room work for three years. It has been used for sawing out dies, strippers, die beds, templets, cam blanks, and dozens of other jobs. We find this method a time saver over any other method suggested, and have been wondering why metal band saws are seldom considered a necessary piece of equipment in the average tool-room or machine shop. MOORE SPECIAL TOOL CO., INC.

Bridgeport, Conn.

Formulas for Radii of Approximate Ellipse

The approximate ellipse constructed with two radii is the most common form of ellipse used by the drafting-room and shop because of the ease with which it can be constructed and its close similarity to the theoretical ellipse. Frequently, it is desirable to know the exact measurements of its elements. Obviously, the construction method is tedious and often impracticable, being subject to accumulative errors during construction. The following formulas, developed to give radii that are mathematically accurate, should therefore save considerable time in laying out work involving the construction of ellipses.

When the major and minor axes and one radius are given, the other radius whose arc would be tangent to that of the given radius may be found by the following formulas, in which the letters represent the elements shown in the illustration:

$$R = r + \frac{(a-r)^2 + (b-r)^2}{2\,(b-r)}$$

$$r = R - \frac{(R-a)^2 + (R-b)^2}{2\,(R-a)}$$

When the major and minor axes only are given and it is desired to find the two radii R and r which will give the nearest approach to a true ellipse, the following formulas may be used:

$$\text{Tan } A = \frac{b}{a}$$

$$r = \frac{b - (a-b)\sin A}{2 \sin A \cos A}$$

$$R = \frac{b + (a-b)\sin A}{2 \sin A \tan A} + r - r \sin A$$

Although the first formula is the one most generally used, the others can often be employed to advantage in connection with jig and die work.

Akron, Ohio W. H. JACOBS

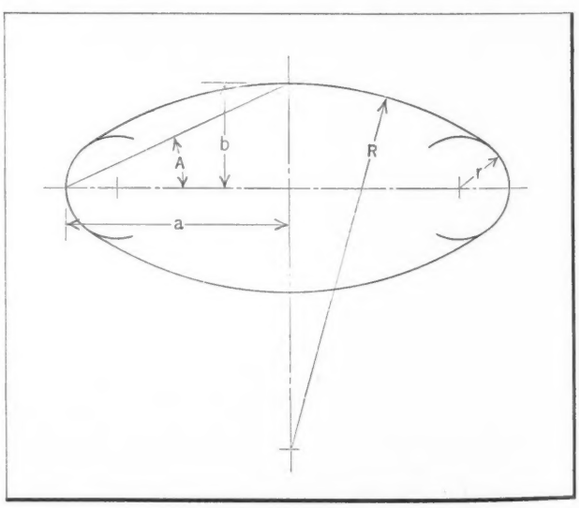
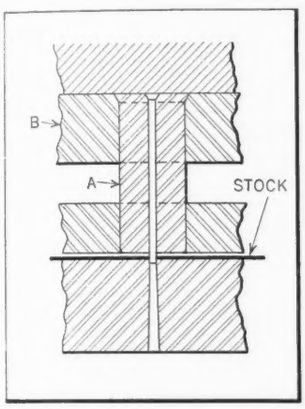


Diagram Illustrating Application of Formulas in Constructing Approximate Ellipse

Supporting a Wire-Piercing Punch

Many methods have been devised for supporting long slender piercing punches. Some diemakers rely upon the stripper plate itself to provide the required support at the lower end of the punch, the upper part being supported by means of a quill. With this arrangement, if the punch is not aligned correctly with the hole in the stripper plate—a condition that often exists—punch breakage is likely to occur. The method shown in the illustration reduces breakage to a minimum, because the punch is supported by the quill *A* down to a point very close to the strip.



Method of Supporting a Slender Piercing Punch so as to Prevent Breakage

The quill may be hardened or left soft, according to the use to which it is to be put. Its outside diameter is a close slip fit in the stripper plate, and it is held in the punch-block by the plate *B*. The end of the quill may also be utilized for flattening the work around the pierced holes. This is done by adjusting the stroke of the press so that the quill will come in contact with the top of the strip at the bottom of the stroke. The upper end of the quill should be left sufficiently soft so that it can be peened over in the plate *B*.

Bloomfield, N. J. J. E. FENNO

Getting the Most out of Data Sheets

To get the greatest possible value out of MACHINERY'S Data Sheets, it will prove a great advantage to mount these sheets on heavy cardboard, cover them with a coat of white shellac to protect them from oil and dirt, and hang them up in the departments or by the machines where the information will be found directly useful.

I have in mind, particularly, the recent sheets on indexing movements. I made a test to determine the value of these sheets and had a man who was a real fast "figurer" determine his indexing movements for a certain job without the aid of the Data Sheets. It took him fifteen minutes to do so. I gave a copy of the sheet to another man, and he had the information he required in exactly two minutes. This shows what can be accomplished by the proper use of these sheets. CHARLES R. WHITEHOUSE

Boston, Mass.

Drilling a Hole Through a Rubber Roll

Recently we were confronted with the problem of drilling a 7/8-inch hole through 12 inches of soft rubber. The rubber was in the form of a round roll, 3 inches in diameter, of the consistency of a Lacrosse ball. The following method of drilling gave very satisfactory results.

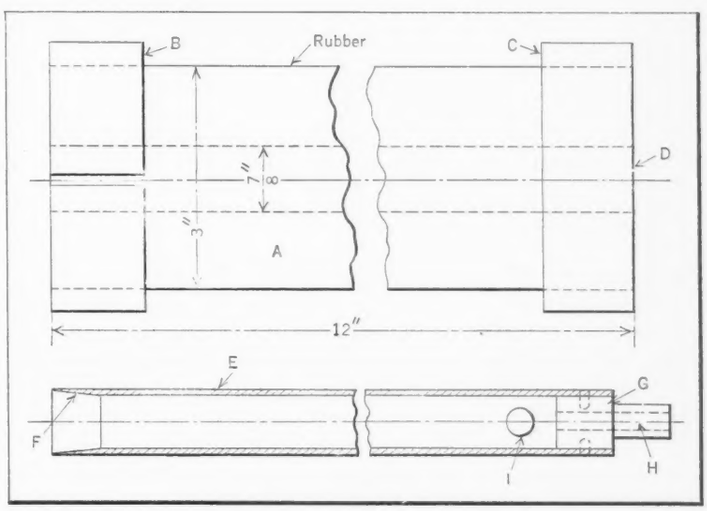
In the accompanying illustration, the rubber roll is shown at *A*. The two steel rings *B* and *C* were fitted over the roll, ring *B* being split in half and gripped in the lathe chuck with just sufficient pressure to drive the work while drilling. The solid ring *C*, fitted over the opposite end of the roll, served as a supporting bearing in the steadyrest. The end of the rubber roll at *D* was bored to a diameter of 7/8 inch for a depth of 1/4 inch, using regular lathe tools.

The drill *E*, consisting of a piece of brass tubing having an outside diameter of 7/8 inch and a wall thickness of 3/64 inch, was then prepared. The cutting end was tapered on the inside at *F* for about 3/4 inch to give a sharp circular edge. No teeth were cut in the tool. The steel head *G* was fitted in one end of the tube as shown. This end was gripped in a small hand chuck which, in turn, was mounted in the tailstock of the lathe.

Whenever the drill was withdrawn for lubricating the cutting end with kerosene, the rubber core broke away from the roll, remaining in the drill or tube. The core was wedged so tightly in the tube that it was necessary to drill a hole *H* through the steel head to permit the use of a steel ejecting-rod. A hole *I* was also drilled in the tube through which the kerosene lubricant was supplied.

After drilling to a depth of 6 inches in one end, the work was reversed in the chuck and the hole completed by drilling from the opposite end. The hole produced was straight and accurate in size, as well as concentric with the cylindrical surface of the roll.

Baltimore, Md. RAYMOND H. DAUTERICH



(A) Soft Rubber Roll; (E) Tubular Drill Used to Cut 7/8-inch Hole the Full Length of Roll A

Questions and Answers

A Department in which the Readers of MACHINERY are Given an Opportunity to Exchange Information on Questions Pertaining to the Machine Industries

M. H. H.—Several months ago I purchased a machine from a salesman. Previous to the salesman's visit, I had written the manufacturer, telling him exactly what I intended to use the machine for. In fact, I explained to the salesman that I intended to cut certain metal with the machine. The contract of sale or order which I signed had no notation that the manufacturer guaranteed the machine. I have paid a part of the purchase price and find that this machine positively is not adapted to cut the kind of metal I intend to work. I have written the manufacturer, but he refuses to take the machine back and will not refund the money. He says that the machine was sold without a guarantee. Have I any legal rights under the circumstances? If so, what can I do?

Answered by Leo T. Parker, Attorney at Law
Cincinnati, Ohio

A manufacturer is not bound by a salesman's guarantee, unless the former acknowledges the same or accepts the order after the salesman writes the provisions of the warranty in the contract of sale. However, the law presumes every person to be trustworthy until proved to the contrary. Frequently, the character of a machine is such that a purchaser is compelled to rely upon the honesty of the seller to supply a machine reasonably fit for the purposes intended. Under these circumstances the Courts imply a warranty on the part of the seller that he will supply a machine reasonably fit to do the intended work, in consideration of the price paid.

In other instances, Courts have held manufacturers to warrant that the merchandise they sell is fit for some special purpose of the buyer's which will not be satisfied by mere fitness of the machine for general purposes. Generally the test is whether the buyer relied upon the seller's good judgment to furnish something that would fulfill the special purpose, and whether the seller knew what the machine was to be used for.

In a recent case (140 S.E. 653), it was disclosed that a manufacturer sold a machine which he said would perform the special service of grinding corn for table use. Later the buyer discovered that whereas the machine would grind corn for table use, it was not specially adapted for this purpose, as its operation was so slow as to prove unprofitable to the user. However, the machine would perform satisfactorily other work for which it was intended. In this case, the Court held the seller bound to refund the purchaser's money and take back the machine.

Laying out Arcs Having Large Radii

F. E. J.—Is there some simple and accurate method for laying out arcs having large radii when their centers lie outside the range of the drafting-board?

Answered by Lewis D. Castor, Elizabeth, N. J.

The following is a simple method that can be employed when, for any reason, it is impractical to use dividers or beam trammels for scribing or laying out arcs having large radii. The height X of the arc, indicated in the diagram, is obtained, when the radius and chord are known, from the formula

$$X = \text{Radius} - \sqrt{(\text{Radius})^2 - (\text{Chord} \div 2)^2}$$

In this case we have

$$X = 40 - \sqrt{40^2 - 5^2}$$

After obtaining the dimension X, it is a simple matter to make a templet such as shown by the dot-and-dash lines. The straight sides A and B of this templet are placed against the two pins located the length of the arc apart. A pencil held on the templet at the apex, or point where the two sides A and B meet, will scribe the required curve when the templet and pencil are revolved, if the sides A and B are kept in contact with the pins. This solution is based on the geometrical proposition that all angles inscribed in the same circle are equal, for they are measured by one-half of the same arc.

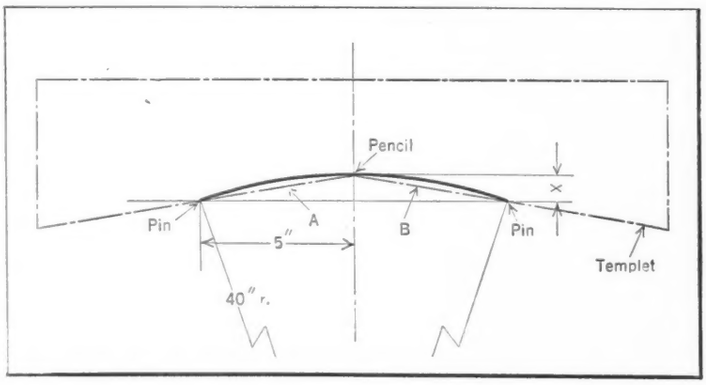


Diagram Illustrating Templet Method of Laying out Arcs Having Large Radii

Permanent Molds for Zinc-Alloy Castings

W. H. B.—The writer read with great interest the article "Permanent Molds for Zinc-Alloy Castings," in July MACHINERY, page 829, and would appreciate any additional information available on the operation of the molds described, as noted in the following questions:

1. Is a commercially prepared alloy used for this type of casting, and if so, under what trade name is it sold?

2. Can this alloy be cast around steel or brass pins so as to adhere firmly?

3. How large is the neck of the gate through which the metal flows into the mold?

4. Is any provision made for venting off the air?

5. Is any kind of lubricant used on the cores?

6. Can the molds be made from either cast iron or machine steel?

7. What is the approximate life (in number of pieces) of a mold such as the one described?

The writer has in mind some work of a similar nature, and wishes to avoid as much unnecessary experimental work as possible.

Answered by Edward Heller, Cleveland, Ohio

The writer is indeed glad to supply the information desired regarding the molds described in July MACHINERY.

1. The pieces were cast from the commercial zinc alloy known as "Horse-head" zinc. However, any other commercial zinc alloy will work very well in this type of mold.

2. This alloy, or any other, can be poured around steel or brass inserts successfully, but the inserts must be preheated before inserting in the mold to prevent chilling or checking. The temperature to which the inserts should be heated depends upon the amount of metal poured around them. Heavy walls require a lower temperature, while thin walls must be poured around inserts of slightly higher temperature.

3. The size of the gate is in most cases a matter of experiment. A very small gate is usually made at first, say 1/16 by 1/2 inch. Then if the metal does not flow fast enough, this gate is enlarged or more gates added. A 3/32- by 3/4-inch gate is usually large enough for castings of the size shown. The illustration, however, showed a round hole, whereas an oblong hole should have been shown, this error in the drawing having escaped notice.

4. Every mold must have provision for releasing the air, and in most cases, minute grooves are filed in the faces at the parting line to let the air escape. In the case of pockets or bosses, the cavities are usually machined clear through to the outside of the mold and then filled with plugs that have a few fine flats filed on their peripheries. These flats provide outlets for the air which would otherwise be trapped within the mold.

5. The cores are usually lubricated with a No. 8 black graphite mixed with a small amount of oil. Care must be taken, however, not to let too much of the lubricant drip on the part of the core that is surrounded by the casting.

6. Cast iron seems to be best adapted for tools of this kind, although fine core-pins, of course, must be made of steel.

7. The life of such a mold depends on so many variables that it is very difficult to make any general prediction regarding the number of pieces that can be produced before the mold must be scrapped or repaired. However, the writer would say that molds of the type described should make 50,000 to 60,000 castings before requiring any major repairs. Of course, the small core-pins will need to be replaced after producing, say, from 3000 to 5000 pieces, and they will require polishing after every few hundred castings are made.

* * *

The Kearney & Trecker Milling Machine Show

A series of interesting demonstrations of the new Milwaukee milling machines (see description in the New Shop Equipment Section of this number) was given by the Kearney & Trecker Corporation, of Milwaukee, Wis., on July 15 to 17. Production experts from various parts of the country attended this milling machine show. The exhibits included detailed descriptions of the new machines and attachments, demonstrations of machine control and of high-speed milling as applied to various parts and materials, the cutting of tapered as well as straight threads on a standard universal tool-room miller, continuous running of a machine spindle at 1500 revolutions per minute from 1:30 P. M. on Monday until 5:00 P. M. on Friday, and various other features relating to these new machines and their application.

MACHINERY'S representative obtained the following data from a few of the milling demonstrations: Simplex type of machine, milling cast-iron cylinder head: Depth of cut, 1/8 inch; table feed, 21 inches per minute; surface speed, 307 feet per minute; cutting time, 75 seconds. Simplex type, milling cast-iron manifold: Depth of cut, 1/16 to 3/32 inch; table feed, 52 1/2 inches per minute; surface speed, 370 feet per minute; cutting time, 25 seconds. Duplex type of machine, milling cast-iron oil-pan: Depth of cut, 1/8 to 5/32 inch; table feed, 21 inches per minute; surface speed, 315 feet per minute; cutting time, 45 seconds. Simplex type of machine, milling cast-aluminum cover plate: Depth of cut, 3/32 inch; table feed, 80 inches per minute; cutting speed 1285 feet per minute; cutting time, 5 seconds.

The 964 visitors who attended the show received an attractive guide book containing descriptions of the forty-three exhibits, bulletins relating to the new machines, and a treatise on "The Latest Developments in Faster Milling with Tungsten and Tantalum Carbide."

Special Tools and Devices for Railway Shops

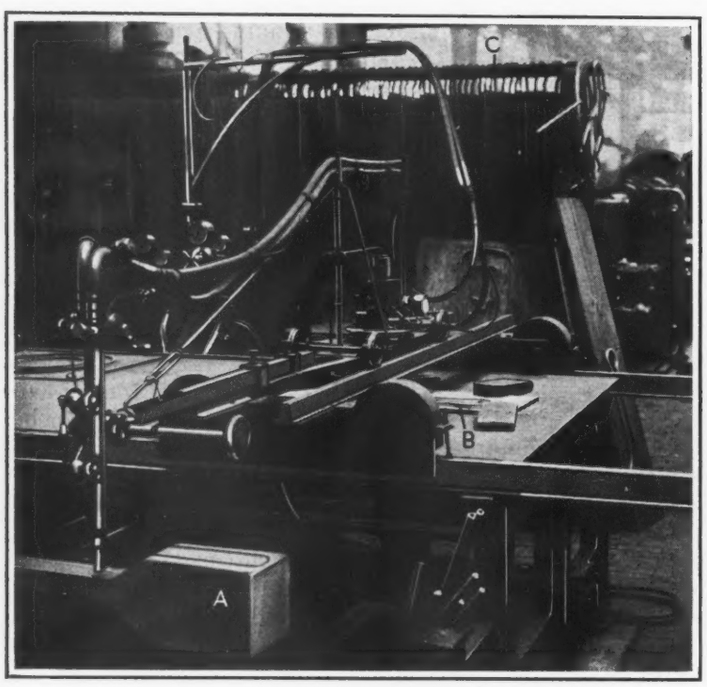
Equipment Employed in Locomotive Repair Shops, Selected by Railway Shop Superintendents and Foremen as Good Examples of Labor-Saving Devices

Oxy-Acetylene Apparatus Saves Forging and Machining

Oxy-acetylene cutting equipment is used extensively in the Montreal shops of the Canadian National Railways for roughly forming such locomotive parts as side, main, and eccentric rods, as well as various valve motion parts. Thus, instead of having to hammer forgings to their approximate size, it is only necessary to forge square-shaped blocks to the ends of comparatively narrow bars. The oxy-acetylene equipment is then employed to shape the ends roughly preparatory to machining. With this method, the amount of stock removed by machining is much less than when the part is produced by hammering, since the outline can be closely controlled through the use of the oxy-acetylene torch.

The illustration shows a typical job. The work at *A* has just been cut to the outline seen on the top by means of the templet *B*, the excess stock not yet having been knocked off. Templets for standard jobs are made of aluminum alloy bars, and are riveted to steel plates such as are seen suspended from the rack *C*. Templets for odd jobs are merely tacked on wooden boards.

Steel up to 10 inches thick has been cut by this method. The practice is to heat all work over 2 inches in thickness to a temperature of from 900 to 1000 degrees F. in order to prevent strains from developing in the cutting, as well as to save gas. All parts are annealed after being cut. Two oxy-acetylene outfits are used in this shop. O. H.



Oxy-acetylene Equipment Used for Cutting Eccentric Rods and Other Locomotive Parts to Approximate Outlines

Self-Gripping Chuck for Locomotive Bushing

By E. A. LOTZ, Foreman
Pennsylvania Railroad Shops, Juniata, Pa.

The accompanying illustrations show the design of a self-gripping, self-centering chuck that has proved very satisfactory for holding the bushings of knuckle-joint pins of locomotive side-rods while they are being turned to fit the rod eyes. The cutting pressure of the tool against the bushing causes the cam-actuated jaws or blocks *A*, Fig. 1, to carry the holding plates *B* around the central cam member *C* until the jaws are given sufficient wedging action to revolve the bushing.

The piece *Y*, secured to cam *C*, comes in contact with the head of screw *X* when the gripping jaws have been expanded to their limit. This stop serves

to prevent the jaws from riding over the high points of the cam lobes. The left half of the serrated surface *E*, Fig. 2, of jaws *A* is turned to size with the cam in the minimum size position, while the right half *F* of the surface is turned with the cam in the maximum position. The important parts and their dimensions are shown clearly in Fig. 2.

Of course self-gripping, self-centering chucks of the design described and illustrated in this article can be made in larger and smaller sizes to accommodate bushings or similar parts in a wide range of sizes.

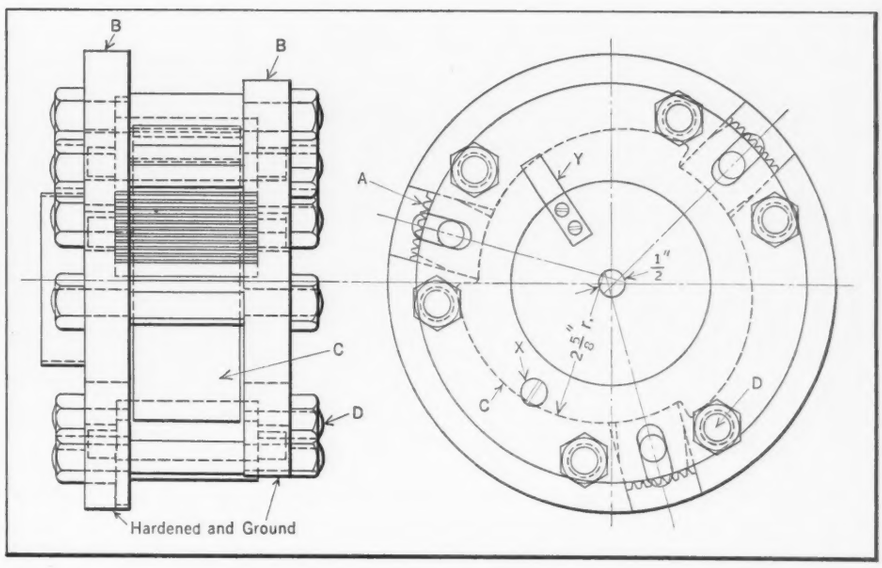


Fig. 1. Self-gripping and Self-centering Chuck Employed to Hold Bushings while they are being Turned to Fit Locomotive Side-rod Eyes

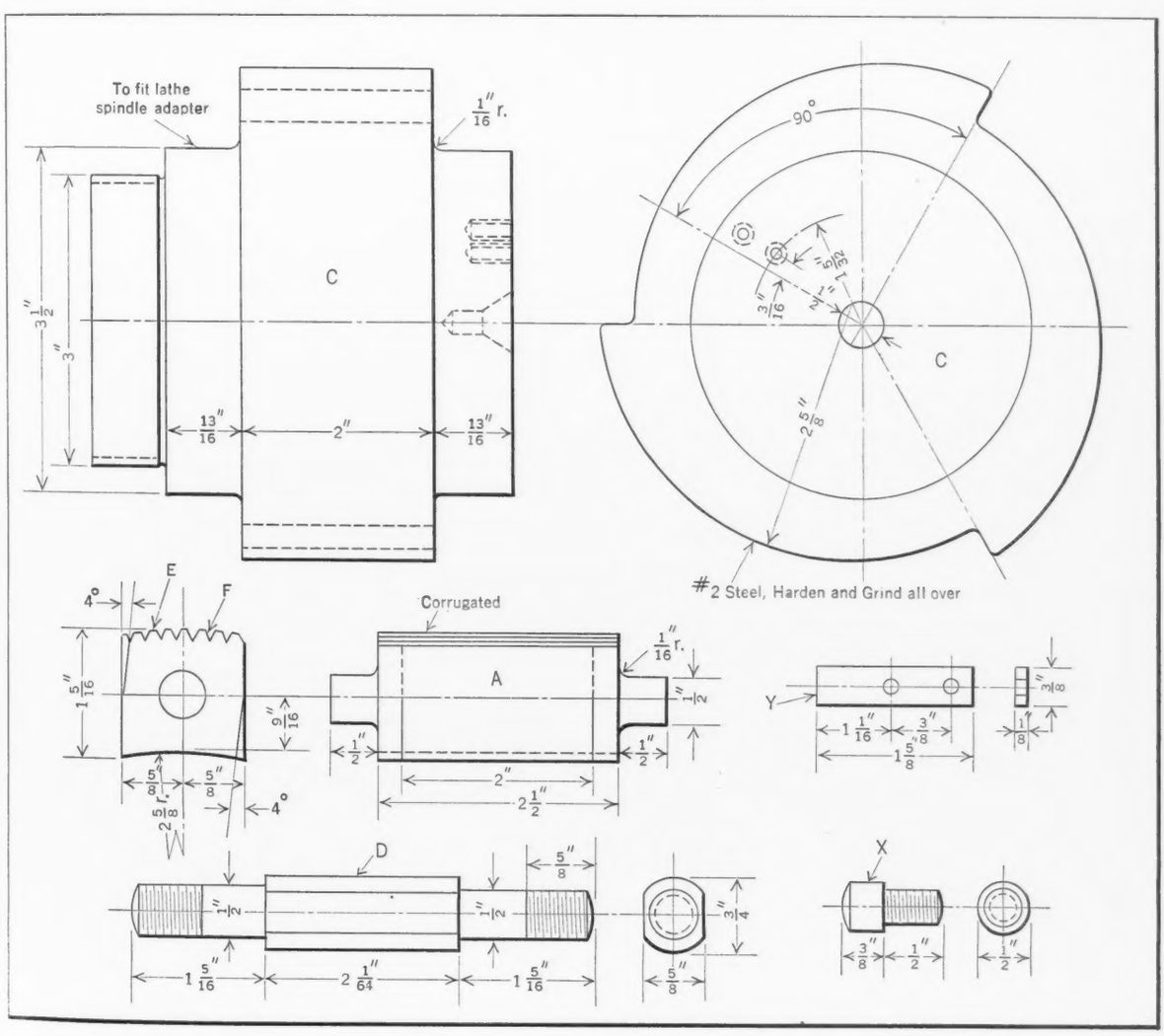


Fig. 2. Details of Parts for Chuck Shown in Fig. 1

Dies for Producing Sheet-Metal Wheels

Die Designs Suitable for Work Requiring Drawing, Reversing, Pinching, and Edging Operations

By CHESTER A. GRAY
The Toledo Machine & Tool Co., Toledo, Ohio

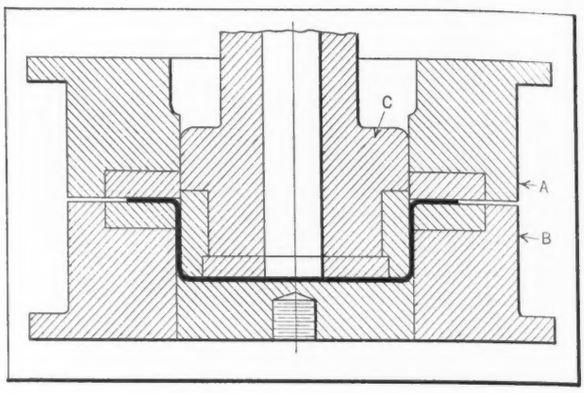


Fig. 1. Cross-section of Drawing Die and Shell Produced in Second Operation on Car Wheel

EACH important step in the evolution of a sheet-metal car wheel from a flat round blank to the completely formed wheel is shown by the cross-sectional views in Fig. 6. The wheels are made in the 12-inch size shown in the half-section view, Fig. 7, and in a smaller 8-inch size. They are used on hand-cars employed by the repair departments of railroads. These hand-cars are operated both by power and by hand.

The first operation in forming a wheel consists of cutting out the round blank with a regular blanking die. The second operation, which consists of drawing the shell to the shape indicated in Fig. 6, is performed by the drawing die shown in Fig. 1. This die is employed on a double-action press. The blank is placed on the lower die and the descending ram causes the blank-holder *A* to hold the work against the top face of the die *B* while the punch *C* pulls the metal from between the two die members.

The third operation, which forms the work to the shape shown in Fig. 6, is performed by means

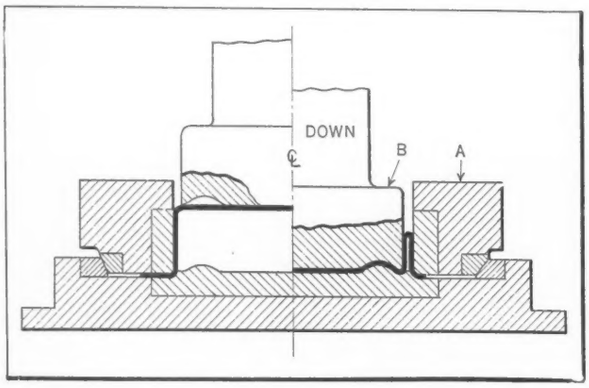


Fig. 2. Reversing Die Used for Third Operation

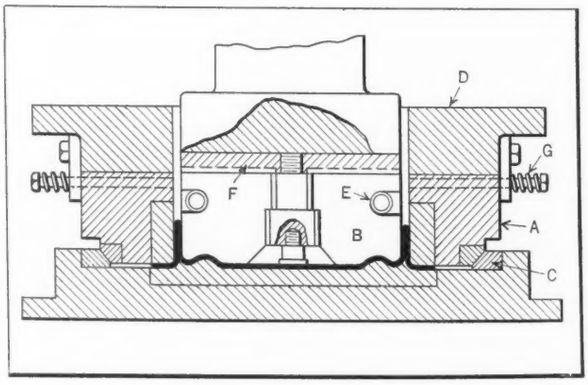


Fig. 3. Die for Pinching or Closing up Flange

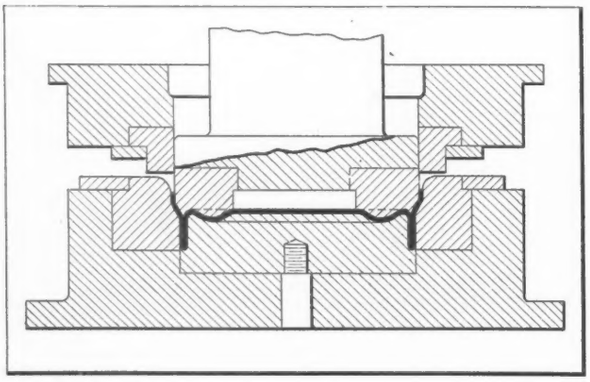


Fig. 4. Die for Edging and Tapering Rim of Wheel

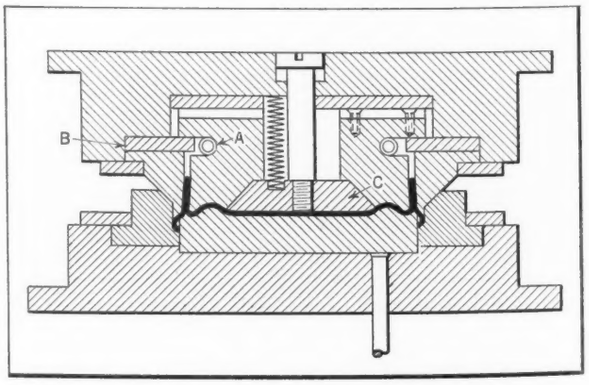


Fig. 5. Die for Forming and Curling Rim of Wheel

of the die shown in Fig. 2. The shell formed by the second operation is placed in the blank-holder *A*, where it is held while the punch *B* forces the bottom of the shell downward so that the shell is practically turned inside out. The blank-holder acts as a stripper. Sufficient clearance is provided to prevent the work from sticking in the holder. This die, also, is used on a double-action press.

Another die used in a double-action press is employed for the fourth operation, which consists of closing the flange, or pinching it together, as shown in Fig. 3. The pinching or closing action is obtained by splitting the outer ring *A* and the inner punch *B*. With this construction, the work will not stick to either the blank-holder or the plunger. The cam ring *C* is beveled and acts as a centering device for the blank-holder *D* to which the split ring *A* is secured. A tension spring *E* serves to hold the split members of the punch *B* in place. The split sections or segments of ring *A* are prevented from falling out by keys that engage T-slots milled on the upper plate *F*. The sections of ring *A* are held in their expanded positions by springs *G*.

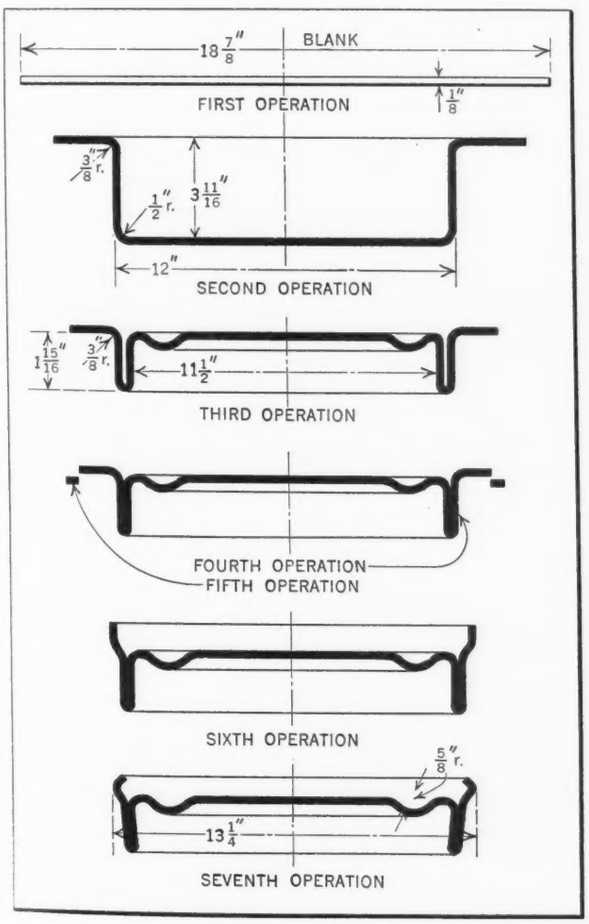


Fig. 6. Cross-section of Work Produced by Successive Die Operations on Car Wheel Blank

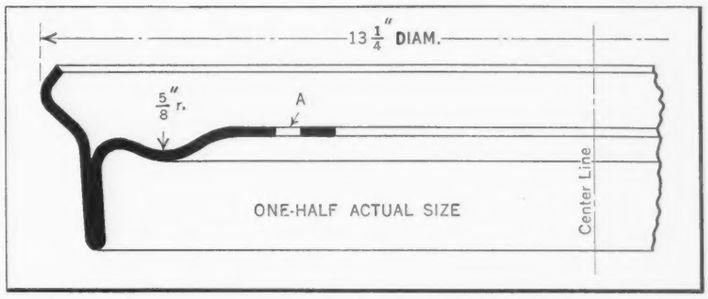


Fig. 7. Half-section of 12-inch Formed Car Wheel

The fifth operation consists of trimming the work, as indicated in Fig. 6, with an ordinary trimming die. The sixth operation is performed on a double-action press, and consists of edging and tapering the rim. The die used for this operation is shown in Fig. 4. In the seventh operation, the rim is formed and curled by the die shown in Fig. 5. The central plug or punch is of the split type, and is held together by a spring *A*. A ring *B* serves to hold the split members in place. The conical member *C* acts as a spring pad for holding the work and also as a driver for expanding the segment members of the forming punch while forming or curling the rim. The final operation on the work consists of blanking out the central portion and piercing holes such as indicated at *A*, Fig. 7.

* * *

International Congress for Testing Materials

An International Association for the Testing of Materials has been organized, with the object of securing international cooperation and exchanging ideas and experience in regard to all matters connected with the testing of materials. It is planned to hold an international congress at intervals of from three to five years at which these matters will be considered. The work, however, will not include the standardization of materials. The members of the Association consist of individuals and companies in the various countries. The national association through which contacts are established is the American Society for Testing Materials, Philadelphia, Pa.

The first international congress will be held this year from September 6 to 12 in Zürich, Switzerland, in the buildings of the Swiss Federal Polytechnicum. The technical program has been divided into four groups dealing with metals; non-metallic, inorganic materials; organic materials; and questions of general importance. A number of Americans will take a prominent part in the program. Those interested may obtain further information from C. L. Warwick, secretary of the American Society for Testing Materials, 1315 Spruce St., Philadelphia, Pa., or from W. H. Fulweiler, representative of the Society on the permanent committee that governs the international association. Mr. Fulweiler is chemical engineer of the United Gas Improvement Co., of Philadelphia.

Allowable Tooth Loads for Bevel Gears

Data for Determining Power Transmitting Capacity of Straight and Spiral Bevel Gears for Industrial Installations

THE horsepower transmitting capacity of gearing not only depends upon the physical properties of the gear materials, but may be affected decidedly by the service conditions under which the gearing operates. The allowable tooth loads for gearing designed primarily for power transmission should not be determined with reference to tooth strength alone, but should be limited to avoid excessive wear. The information that follows is based upon the recommended practice of the American Gear Manufacturers' Association and represents the work of the Bevel and Spiral Bevel Gear Committee.

Table 1 gives the maximum allowable load values on the basis of tooth wear. These loads are per inch of active face width. The table applies directly to spiral bevel gears. For straight bevel gears, 80 per cent of the values should be used. This table is based on the use of casehardened steel for both pinion and gear. For other materials, multiply the values in Table 1 by the material factors given in Table 2.

Table 1. Maximum Allowable Loads for Spiral Bevel Gears as Limited by Tooth Wear

Teeth in Pinion	Diametral Pitch									
	1 1/2	1 3/4	2	2 1/2	3	4	5	6	8	10 and Finer
	Tangential Load at Pitch Line per Inch of Active Face, Pounds									
8– 9	1085	1005	940	840	765	675	595	540	470	420
10–11	1215	1125	1050	940	855	750	665	600	525	470
12–14	1330	1230	1150	1025	935	825	725	660	575	515
15–18	1480	1375	1285	1145	1050	910	815	740	645	575
19–23	1770	1545	1445	1295	1180	1025	915	835	725	645
24–29	1875	1740	1620	1450	1325	1155	1025	935	815	725
30 & up	2100	1940	1815	1620	1480	1290	1150	1045	910	810

The values in this table are based upon the use of casehardened steel for both gear and pinion. For other materials, multiply by factors in Table 2.

For straight bevel gears use 80 per cent of the load values given in this table.

The service conditions under which gears operate may be a very important factor in determining the allowable load capacity. For example, it is essential to know whether the maximum load is to be continuous, whether shock loads are to be encountered, the duration of any overloads, and the method of lubrication. Suggested service factors for various types of installations are given in Table 3. It may be desirable to change some of these factors to suit specific installations as, for example, when experience indicates that other factors are applicable.

The load values given in Table 1 are based upon continuous operation at the rated load, without shock; 50 per cent overload at starting; 50 per cent momentary overload; proper assembly in rigid mountings; good lubrication; and a maximum stress not exceeding two-thirds of the ultimate strength of the material.

To illustrate the practical application of Tables 1, 2, and 3, assume that the horsepower transmitting capacity of spiral bevel gears, conforming to the following specifications, is required. The pinion is made of casehardened steel and the gear of heat-treated steel. The pinion has 15 teeth of 6 diametral pitch; the face width is 2 1/4 inches; the pitch-line velocity, 670 feet per minute; and the gearing is to be used in connection with a machine tool transmission having a direct motor drive.

Table 1 shows that, for a pinion of 15 teeth and of 6 diametral pitch, the load per inch of active face is 740 pounds. Since the pinion is casehardened and the gear is heat-treated, the load value is multiplied by the material factor of 0.5 found in Table 2. Hence, $740 \times 0.5 = 370$ pounds.

This load is further reduced by the service factor for machine tools (direct motor drive) in Table 3. The service factor in this case is 0.65. Therefore, the allowable tooth load per inch of active face is $370 \times 0.65 =$ 240 pounds

As the face width is 2 1/4 inches, the total allowable tangential load W at the pitch line is:

$$240 \times 2\ 1/4 = 540 \text{ pounds}$$

The complete formula for determining the total load value is as follows:

$$W = 470 \sqrt{\frac{N}{DP}}\, C_m\, C_s\, F$$

in which

W = *total* tangential load at pitch line, in pounds;
N = number of teeth in pinion;
DP = diametral pitch;
C_m = material factor;
C_s = service factor; and
F = active face width, in inches.

The horsepower corresponding to the total allowable tangential load and speed is determined by

Table 2. Material Factors

Based Upon the Present Practice of the Gleason Works and the Results of Observation and Experience over a Number of Years

Pinion Material	Gear Material	Factor C_m
Cast Iron or Soft Steel	Cast Iron	0.30
Heat-treated Steel	Heat-treated Steel	0.35
Casehardened Steel	Cast Iron	0.40
Oil-hardened Steel	Cast Iron	0.40
Casehardened Steel	Soft or Cast Steel	0.45
Oil-hardened Steel	Soft or Cast Steel	0.45
Casehardened Steel	Heat-treated Steel	0.50
Oil-hardened Steel	Heat-treated Steel	0.50
Oil-hardened Steel	Oil-hardened Steel	0.80
Casehardened Steel	Oil-hardened Steel	0.85
Casehardened Steel	Casehardened Steel	1.00

These material factors are also based upon the hardness factors listed below:

	Brinell	Scleroscope	Steels Commonly Used
Soft Steel	160–190	25–28	S.A.E. 1035
Heat-treated Steel	200–260	30–36	S.A.E. 2335 S.A.E. 3140
Oil-hardened Steel	.....	70–80	S.A.E. 3245
Casehardened Steel	.....	80–90	S.A.E. 2315 S.A.E. 2512 S.A.E. 3312X

multiplying the load value W by the pitch-line velocity V, in feet per minute, and dividing the product by 33,000. In this example,

$$\text{Horsepower} = \frac{540 \times 670}{33{,}000} = 11$$

If bevel gears having straight teeth were substituted in the example referred to, 80 per cent of the load for spiral bevel gears would be used, the horsepower capacity in that case being reduced 20 per cent.

Table of Strength or Y Factors

Although it is essential to limit the tooth loads so as to avoid excessive wear, the Lewis formula may be used as a check to make sure that the teeth have sufficient beam strength. Table 4 gives the strength factors Y for various numbers of pinion teeth and gear ratios equal to $\frac{\text{Number of gear teeth}}{\text{Number of pinion teeth}}$. These factors are from the Gleason Works system of bevel gears. The pressure angle of this system is 14 1/2 degrees when the pinion has 12 teeth or more except for miter gears and near miters of low numbers of teeth. For miters, near miters, and smaller pinions of certain ratios, the pressure angle is made either 17 1/2 or 20 degrees to prevent excessive under-cut. These Y factors are used in conjunction with the Lewis formula as arranged for diametral pitch. (See Formula 3, page 685, MACHINERY'S HANDBOOK.)

In reducing the allowable static stress S_s to obtain the operating or running stress S, a higher value S is used than is obtained by the velocity factor commonly used with the Lewis formula. Thus,

$$S = S_s \times \frac{1200}{1200 + V}$$

This formula gives a higher operating stress than the Lewis factor, which is $\frac{600}{600 + V}$. To illustrate, if the pitch-line velocity is 1200 feet per minute, then the operating stress, using the Lewis factor, would be one-third of the static stress, in pounds per square inch; the operating stress would equal one-half the static stress using the factor $\frac{1200}{1200 + V}$.

Application of the Lewis Formula

The example previously given will be used to illustrate the application of the Lewis formula. We will assume that the pinion of 15 teeth is used with

Table 3. Service Factors Used in Determining the Allowable Tooth Loads

Allowable Loads Given in Table 1 are Multiplied by the Service Factors that Follow to Obtain the Load Values for Different Types of Drives

Type of Drive	Service Factors
Agitator (Tank)	1.0
Air Compressor	0.75
Airplane and Airship	1.0–1.5
Air Separator	1.0
Baking Machinery	1.0
Blowers and Fans	1.0
Centrifugal Extractors	1.0
Coal Dryers (Rotary)	1.0
Cloth Cutters	1.0 (check for static stress)
Coal and Rock Screen Drive	1.0
Coal and Rock Crushers	0.5
Conveyors	0.65–1.0
Dredging Machinery	0.65
Electric Tools (Portable)	0.75 (check for high torque at low speeds)
Glass Manufacturing Machinery	1.0
Hoisting Machinery	1.0–1.3
Machine Tools	
1. Direct Motor Drive	0.65
2. Belt Drive	1.0
3. Intermittent Belt Drive	1.3
Mining Machinery	0.75
Motor Boat	1.0
Motorcycle	2.0
Paper Machinery	1.3 (Based on starting torque)
Pneumatic Tools	0.75
Printing Machinery	1.0
Pulverizers (Coal and Cement)	1.0 (on overload basis)
Pumps	
1. Centrifugal	1.0
2. Reciprocating	0.65
Railway Motor Cars	
1. Based on Starting Torque	2.0
2. Based on Normal Running Load	0.5
Road Machinery	65.0–1.0
Rolling Mill	5.0–0.75
Speed Reducers	1.0
Textile Machinery	1.0
Washing Machines	1.0
Well Drilling Machinery	0.75
Wire Drawing Machinery	0.75
Woodworking Machinery	1.0

a gear having 54 teeth, and that the value of S_s is 20,000 pounds per square inch. Then:

$$S = 20{,}000 \times \frac{1200}{1200 + 670} = 12{,}830 \text{ pounds per square inch}$$

The ratio of this gearing is $\frac{54}{15} = 3.6$, and as the pinion has 15 teeth, the Y factor, according to Table 4, is 0.392.

The cone distance (or pitch cone radius) equals 4.67 inches; hence, according to the Lewis formula,

$$W = \frac{12{,}830 \times 2.25 \times 0.392 \times (4.67 - 2.25)}{6 \times 4.67} =$$

977 pounds

$$\text{H.P.} = \frac{977 \times 670}{33{,}000} = 19.8$$

This result shows that there is ample tooth strength, and that the tooth load in this case should be limited to the value given in Table 1 in order to safeguard against excessive wear.

A coming article ("How Much Power Should Gears Transmit?") deals with the allowable tooth loads on spur gears as limited by impact resistance and wear, giving the results of tests requiring six years.

Table 4. Strength or Y Factors for Gleason Works System of Bevel Gears

Number of Pinion Teeth	Ratios = Number of Gear Teeth ÷ Number of Pinion Teeth														
	1.00 to 1.25	1.25 to 1.50	1.50 to 1.75	1.75 to 2.00	2.00 to 2.25	2.25 to 2.50	2.50 to 2.75	2.75 to 3.00	3.00 to 3.25	3.25 to 3.50	3.50 to 3.75	3.75 to 4.00	4.00 to 4.50	4.50 to 5.00	5.00 to ∞
	Y Factors for Spiral Bevel Gears														
5	0.297	0.322	0.343	0.361	0.376	0.388	0.398	0.406	0.411	0.416	0.420	0.424	0.431	0.438	0.450
6	0.310	0.332	0.353	0.372	0.386	0.398	0.406	0.414	0.419	0.424	0.428	0.431	0.436	0.443	0.452
7	0.318	0.333	0.347	0.360	0.373	0.384	0.392	0.398	0.405	0.410	0.415	0.419	0.426	0.432	0.439
8	0.298	0.320	0.336	0.348	0.357	0.366	0.373	0.379	0.384	0.388	0.392	0.394	0.397	0.400	0.405
9	0.292	0.313	0.327	0.338	0.346	0.352	0.357	0.363	0.367	0.370	0.373	0.376	0.380	0.384	0.388
10	0.315	0.338	0.353	0.363	0.371	0.345	0.326	0.342	0.351	0.357	0.363	0.367	0.371	0.374	0.377
11	0.316	0.335	0.343	0.325	0.327	0.333	0.338	0.344	0.350	0.356	0.361	0.367	0.375	0.384	0.390
12	0.298	0.318	0.333	0.343	0.351	0.357	0.363	0.368	0.372	0.377	0.379	0.381	0.384	0.386	0.388
13	0.302	0.320	0.334	0.343	0.351	0.358	0.365	0.371	0.376	0.381	0.384	0.386	0.388	0.391	0.393
14	0.306	0.322	0.334	0.345	0.354	0.362	0.369	0.374	0.378	0.382	0.386	0.389	0.391	0.393	0.395
15	0.314	0.330	0.342	0.352	0.360	0.368	0.374	0.380	0.385	0.389	0.392	0.394	0.397	0.399	0.402
16	0.322	0.335	0.347	0.358	0.367	0.374	0.381	0.386	0.390	0.394	0.397	0.400	0.402	0.404	0.406
17–18	0.329	0.343	0.354	0.364	0.373	0.382	0.389	0.394	0.398	0.400	0.403	0.406	0.407	0.409	0.410
19–21	0.339	0.351	0.362	0.373	0.382	0.389	0.396	0.401	0.405	0.407	0.410	0.411	0.412	0.414	0.415
22–25	0.351	0.363	0.373	0.382	0.391	0.398	0.403	0.407	0.410	0.412	0.413	0.414	0.415	0.417	0.418
26–30	0.364	0.374	0.384	0.393	0.399	0.404	0.407	0.410	0.412	0.414	0.415	0.416	0.417	0.418	0.419
No. of Pinion Teeth	Y Factors for Straight Bevel Gears														
10	0.231	0.260	0.280	0.294	0.305	0.315	0.324	0.332	0.340	0.347	0.353	0.358	0.365	0.371	0.377
11	0.268	0.264	0.273	0.286	0.296	0.303	0.309	0.315	0.320	0.324	0.328	0.332	0.336	0.340	0.342
12	0.248	0.265	0.281	0.295	0.308	0.318	0.328	0.335	0.341	0.345	0.348	0.351	0.353	0.355	0.356
13	0.264	0.278	0.291	0.280	0.278	0.286	0.291	0.295	0.298	0.299	0.301	0.303	0.305	0.307	0.310
14	0.242	0.254	0.263	0.272	0.281	0.288	0.294	0.299	0.304	0.307	0.310	0.313	0.316	0.318	0.319
15	0.248	0.258	0.266	0.274	0.283	0.290	0.296	0.301	0.305	0.308	0.312	0.315	0.318	0.319	0.320
16	0.252	0.261	0.269	0.277	0.285	0.292	0.298	0.304	0.308	0.312	0.314	0.317	0.319	0.321	0.323
17–18	0.257	0.265	0.273	0.281	0.288	0.295	0.302	0.307	0.311	0.315	0.318	0.320	0.322	0.325	0.326
19–21	0.265	0.272	0.279	0.286	0.294	0.300	0.307	0.312	0.317	0.320	0.324	0.326	0.328	0.330	0.332
22–25	0.274	0.281	0.288	0.295	0.301	0.307	0.314	0.319	0.324	0.327	0.331	0.332	0.335	0.337	0.338
26–30	0.284	0.291	0.297	0.304	0.310	0.317	0.322	0.327	0.332	0.336	0.339	0.342	0.344	0.346	0.347

Proper Care of Bolts and Clamps

By D. A. BAKER

Of the troubles encountered by machinists in some shops one is that of having to search for suitable bolts, nuts, and clamps for setting up a job. With no system of caring for these important adjuncts, they often find their way to some inaccessible recess beneath a bench. Often they are distorted, with the threads stripped or the nuts lost. Furthermore, they may be too long or too short for the job, or the heads may be either too large or battered so that they will not slide freely in the T-slots.

How much simpler and more economical it would be if a suitable rack were erected in a place convenient to the machines. On this rack each bolt could be hung by its head on two projecting parallel pins, while clamps could be hung on single pins. With an arrangement like this, a casual glance at the rack would inform a man whether the bolt or clamp required were available. Also, the foreman could obtain some idea of the stock of bolts and clamps on hand and their condition. Another suggestion offered is to pack-harden the clamps and bolts. The latter should have the temper drawn sufficiently so that the threads would not be brittle. If this is done, they will give several times longer service than if left soft.

Equipment for Machining Steel Gear-Rings

Chucks and Tools Designed for the Production of Steel Rings or Bands in which Gear Teeth are Cut

By I. F. YEOMAN

GEARS consisting of a cast-iron core or hub surrounded by a steel ring in which the teeth are cut are often employed when maximum tooth strength is desirable. This construction is especially adapted for large gears when the cost of a solid forged gear is prohibitive. Gears of the steel ring type are generally as durable as the solid forged product, and in most cases, while costing considerably less than cast-steel gears are usually more satisfactory.

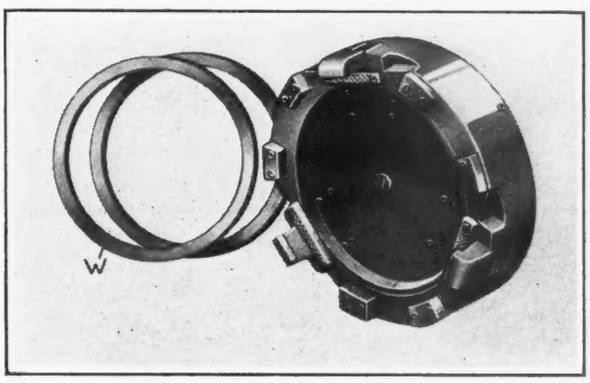


Fig. 1. Steel Gear-rings and Chuck Employed in Machining the Inner Surfaces of the Rings

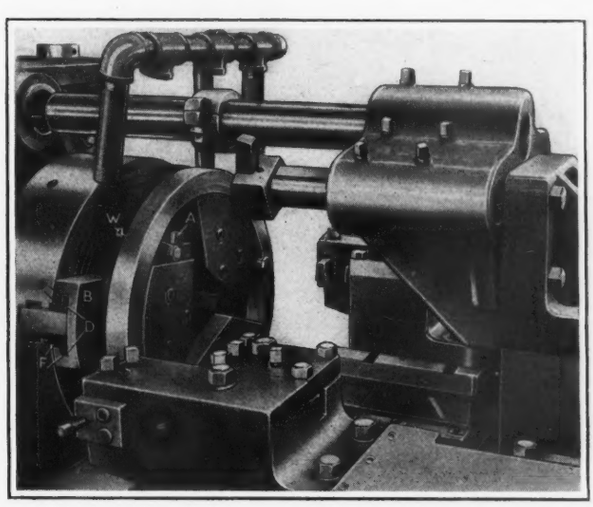
In most cases it is desirable to employ multiple turning operations for producing the steel rings for such gears in quantity. It is sometimes difficult, however, to chuck the work securely without distorting it. The methods described here are employed for chucking and finishing steel rings of two sizes. The smaller size shown at *W*, Fig. 1, has an outside diameter of 22 1/4 inches, an inside diameter of 19 1/2 inches, and a width of 1 5/8 inches. The larger ring, shown at *W*, Fig. 7, has an outside diameter of 25 3/4 inches, an inside diameter of 22 1/2 inches, and a width of 4 inches. While the equipment described here is shown on a Foster Fastermatic, it can be readily applied to almost any type of turret lathe.

The first chucking operations on the smaller ring consist of rough-turning the outside diameter and rough-facing the two sides, followed immediately by finish-turning the outside diameter and finish-facing the sides with the set-up shown in Fig. 2. The rough-facing cutters are located on the front cross-slide, and the finish-facing cutters on the rear cross-slide. The finish-turning cutter—not shown—starts its cut as soon as the rough-turning cut is completed.

A three-jaw air chuck equipped with special compensating jaws is used to hold the work *W*. The construction of the compensating jaws is shown in Fig. 3. A swinging V-block *A*, Fig. 2, for locating the ring is attached to each jaw. These V-blocks are swung inward so that they clear the tools when the cuts are taken.

The jaw *A*, Fig. 3, is a hardened plate secured to the swivel-jaw *B*. The swivel-jaw is attached to the master jaw *C* by two ledges, as shown at *D*, Fig. 2. The jaw *B*, Fig. 3, is grooved to give a good sliding fit between the under side of the ledges *D*, Fig. 2, and the face of the chuck. Also, the groove is made wider than the master jaw at *F* to provide sufficient movement for the compensating action required. The jaws swivel about the pin *E*, Fig. 3. The ring is gripped at six places. With this construction, it is an easy matter to design the jaws so that they will be in contact with practically the entire inner surface of the work.

Fig. 2. Set-up for Turning the Outside and Facing the Sides of the Gear-rings



The second chucking operations consist of rough- and finish-boring the ring. The same turning head with the cutter-bars relocated is used for these operations. However, the cross-slide tools are not required in this case.

The chucking fixture is shown at the right, Fig. 1. The gripping and driving action is confined entirely to the finished sides, as shown by the cross-section view, Fig. 4. Six lugs *A*, attached rigidly to the fixture body, locate the work concentrically. Three hooked fingers *B* are brought over the outer face of the ring by the rearward movement of spider *C*. This movement serves to clamp the ring securely against the corrugated plates *E*. When spider *C* is released, the fingers move forward and the pivot *D* allows the hooked ends to move outward so that they clear the work.

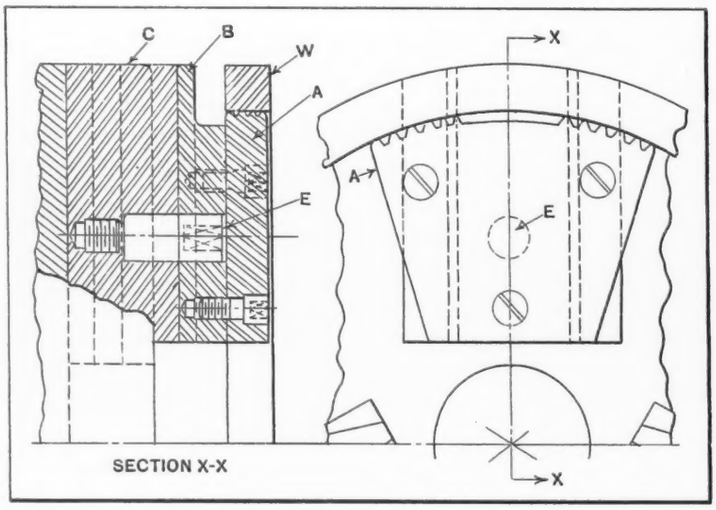


Fig. 3. Construction Details of the Compensating Jaw Used on Chuck Illustrated in Fig. 2

Figs. 5 and 6 show a Fastermatic equipped with a slide and other special features for turning the outside and facing the sides of the larger ring, shown at *W*, Fig. 7. Heavy feeds are used for facing and turning this ring, both for the roughing and finishing operations. The outside is rough-turned by cutter *A*, Fig. 5, and the sides are faced by the two cutters in the front cross-slide. The cutter *B* for finish-turning is carried on the same slide as cutter *A* and starts the finishing cut immediately after the roughing.

The sides are finish-faced at the same time, the feed being greatly increased for the finishing cuts. This is accomplished through one of the overhead pilot-bars which actuates an air valve through lever *G*, Fig. 6. An auxiliary air cylinder

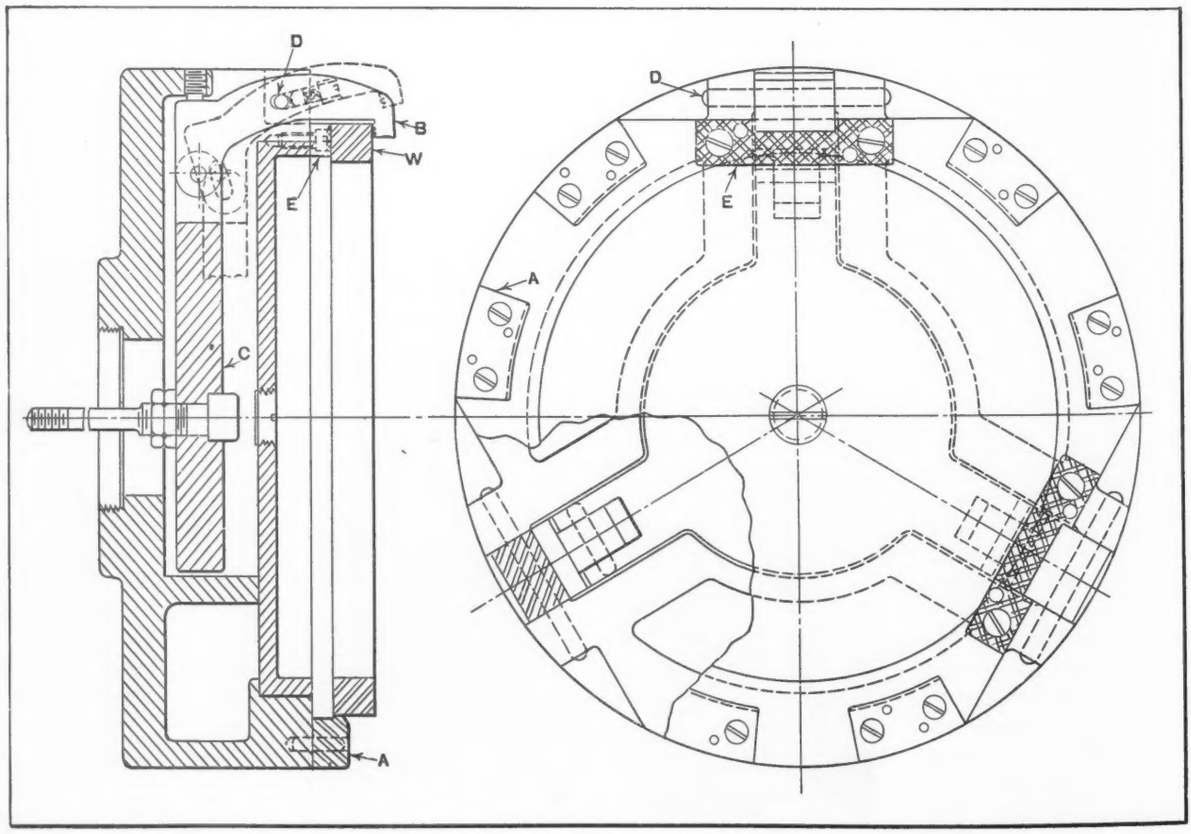


Fig. 4. Sectional and Plan Views of Chuck Illustrated at the Right in Fig. 1

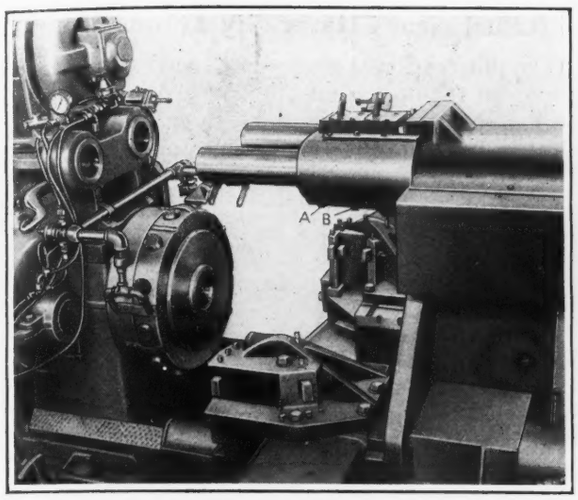


Fig. 5. Turret Lathe Set-up for Turning and Facing Large Size Gear-rings

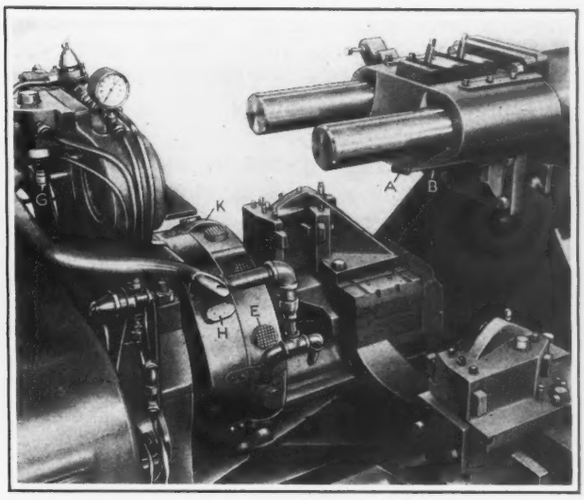
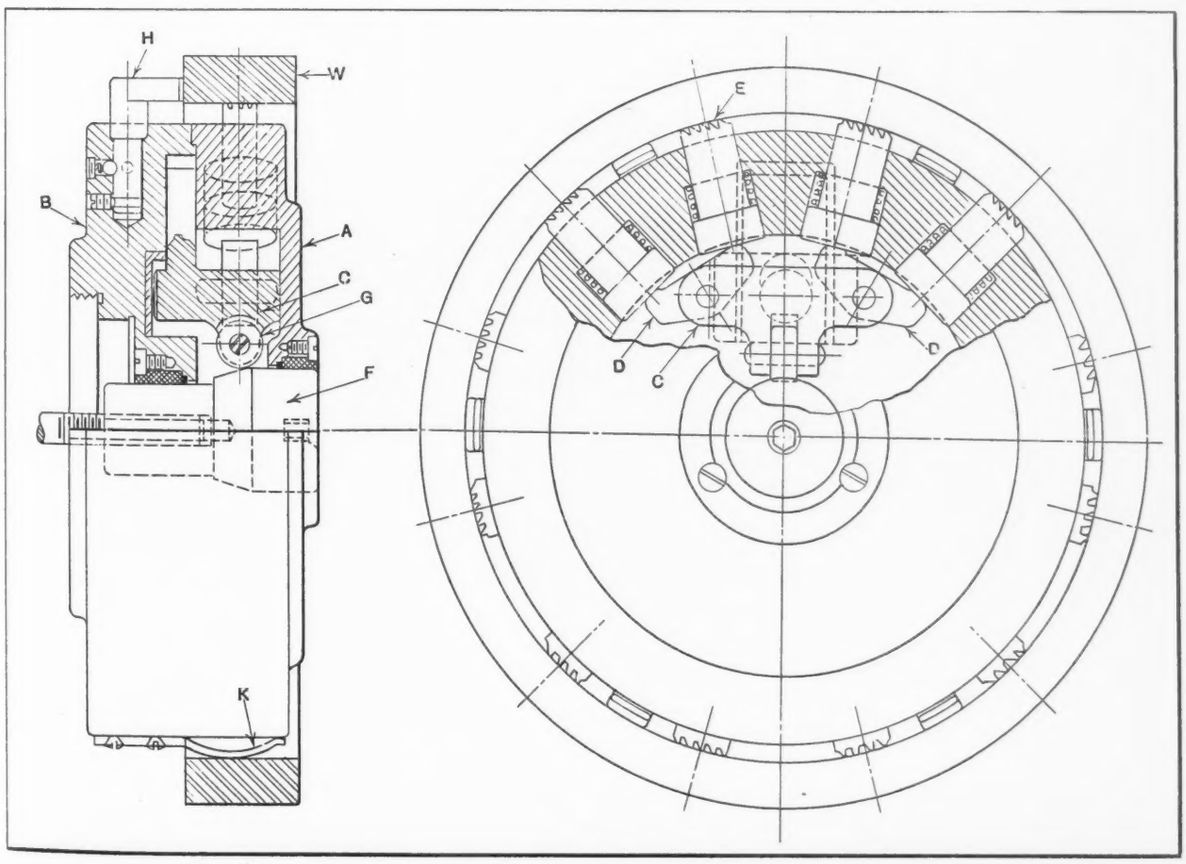


Fig. 6. Equipment Illustrated in Fig. 5, Looking toward the Rear of the Machine

is controlled by this valve which increases the volume of oil supplied by the Oilgear feed. This action takes place at the completion of the roughing cut, and is continued until the finishing cut is completed.

The chuck used for this work is of rather unusual design. It has twelve compensating jaws like the one at *E*, and is air-operated. The design and construction of this chuck is shown in Fig. 7. The body of the chuck is made in two parts, *A* and *B*. The grooves that re-

Fig. 7. Design of Compensating Jaws of Chuck Illustrated in Figs. 5 and 6



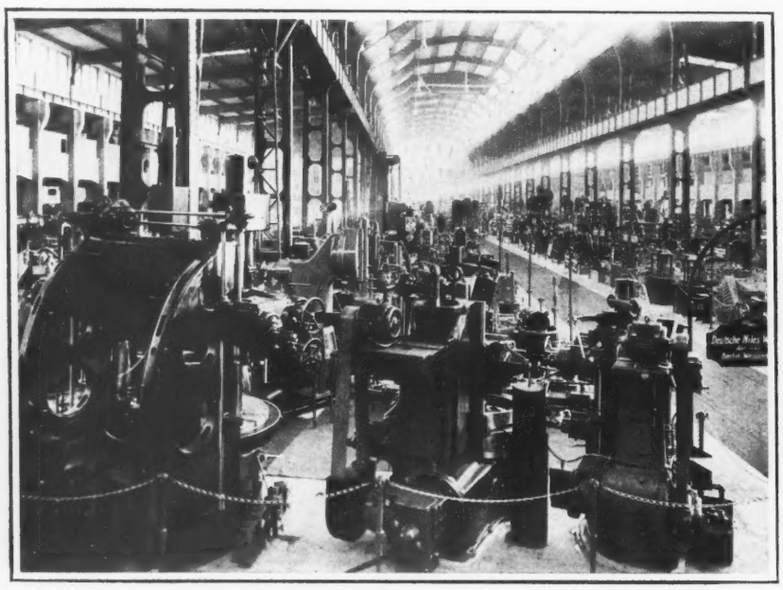
ceive the three master jaws *C* are steel-lined and are located 120 degrees apart. Each master jaw carries two rockers *D*, so arranged that their ends will center against the jaws *E*, which are located 30 degrees apart.

A taper plug *F*, actuated by an air cylinder, effects the opening and closing movement through its action on the roll *G*, which is carried in the master jaw. Three stops *H*, Figs. 6 and 7, can be swung into position by hand for locating the work. These stops are readily swung aside by the tools. Six heavy flat springs *K* project above the jaws when the latter are in the released position. These springs assist in carrying the work over the jaws during the process of loading the chuck. The cross-slide tools are shown in Figs. 5 and 6.

* * *

Leipzig Trade Fair

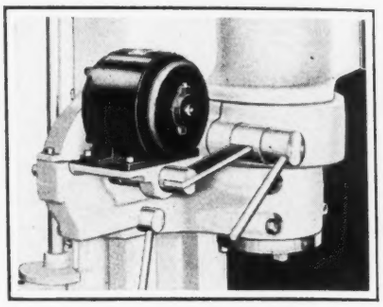
Leipzig Trade Fair, Inc., 10 E. 40th St., New York City, has announced that the fall fair will be held from August 30 to September 3. It is believed that this fair will attract 180,000 buyers from 72 countries, including 1500 from all parts of the United States. This country will also be represented by about 200 exhibits. The Leipzig Fair maintains 326 representatives throughout the world to facilitate trade relations, and this highly organized machinery is placed at the disposal of all countries having business relations with Germany. Every variety of standard merchandise, with the latest novelties conveniently grouped, is exhibited at the Fair. The displays combine the appeal of a world exposition with the conveniences of a great business exchange. About 7500 exhibits are housed in sixty buildings, especially planned for the convenience of visiting buyers and exhibitors.



General View of Machinery Hall at the Leipzig Fair, Showing Part of the Machine Tool Exhibit

Radial Arm Clamped by Torque Motor

The illustration shows a slow-speed torque motor employed for operating the arm clamp of a radial drilling machine built by the Western Machine Tool Works. The clamp is self-locking, and consequently, the current to the motor may be cut off when the arm is clamped. However, as the motor is wound for twenty-four-hour service, no harm will result if the operator should forget to turn the current off when the equipment is not in use. The motor is reversed to release the clamp. This motor is made by the Ohio Electric Mfg. Co., Cleveland, Ohio.



Torque Motor Used for Operating the Arm Clamp of a Radial Drill

* * *

Black & Decker Awarded Bronze Safety Trophy

During the last six months, seventy-nine manufacturing plants in and around Baltimore have been competing in a safety campaign organized by the Baltimore Safety Council for the purpose of stimulating greater interest in the elimination of lost-time accidents. It is now announced that the bronze trophy award will be given to the Black & Decker Mfg. Co., Towson, Md., for its remarkable record in accident prevention. During the period of the campaign, this company did not have a single lost-time accident.

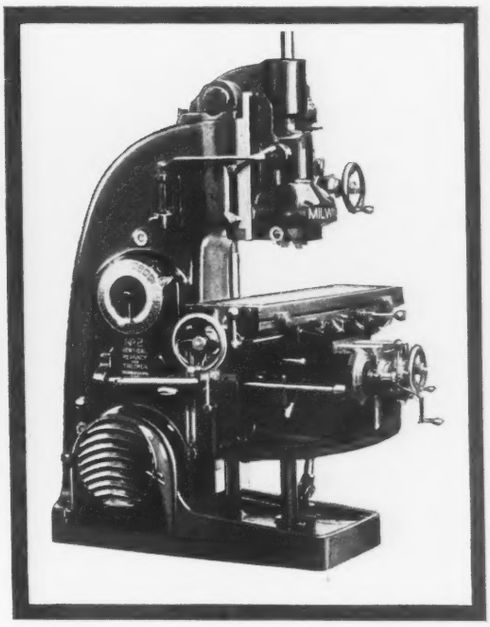
* * *

Comparative Number of Automobiles Used in Different Countries

The total number of automobiles in use throughout the world is 35,600,000, of which three-quarters are registered in the United States. In this country, there is a motor vehicle for every five people. New Zealand comes next on the list with one for every seven people; Canada with one for every eight, and Australia with one for every eleven. In Europe, England leads with one motor vehicle for every twenty-seven people, followed closely by France with one for every twenty-eight, Denmark with one for every thirty-one, Sweden with one for every forty-two, and Switzerland with one for every forty-nine inhabitants.

New Shop Equipment

Latest Developments in Machine Tools, Unit Mechanisms, Machine Parts, and Material Handling Appliances



Milwaukee Knee-Type Milling Machines

Spindle speeds of from 15 to 1500 revolutions per minute and feeds of from 1/4 to 60 inches per minute are available in a new series of knee-type Milwaukee milling machines now being introduced on the market by the Kearney & Trecker Corporation, Milwaukee, Wis. Other important new features of these machines are a center-bearing spindle with a worm drive; a sponson type of knee; and a multiple V-belt drive with the motor positioned at right angles to the spindle. The dividing head is a new design in which the customary worm gearing has been replaced by a hypoid spiral-bevel gear and pinion. This permits the cutting of short leads by power and many other operations that were previously impossible.

The new milling machines are available in two sizes, Nos. 1 and 2, each of which is built in universal, plain, and manufacturing horizontal types, as well as in plain and manufacturing sliding-head vertical types. The machines are designed with a view to using tungsten- and tantalum-carbide milling cutters.

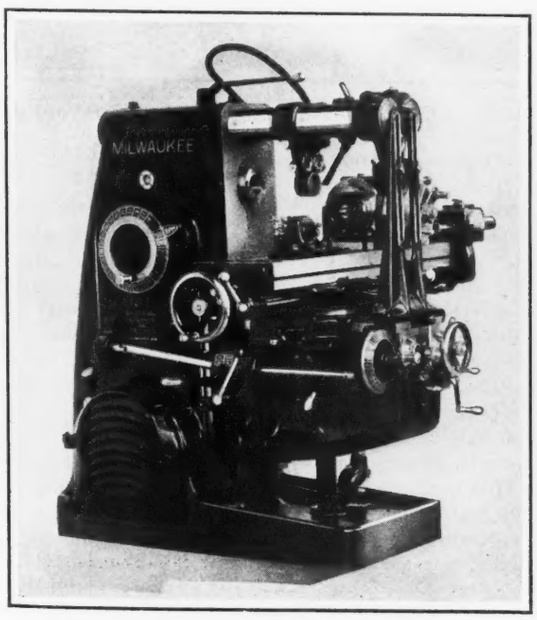


Fig. 1. Milwaukee Universal Knee-type Milling Machine with Large Speed and Feed Range

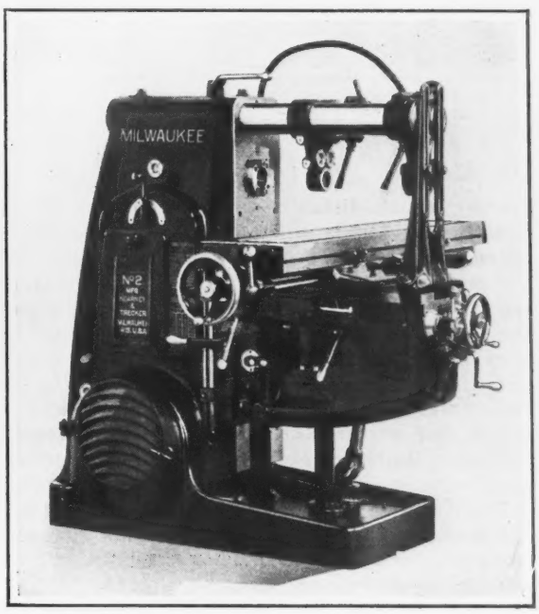


Fig. 2. Manufacturing Type of Machine with Pick-off Gears for Speed and Feed Changes

The 100 to 1 spindle speed range provided permits surface speeds in either direction as low as 50 feet per minute for a 12 1/2-inch diameter cutter, and as high as 100 feet per minute for a 1/4-inch cutter. In order to avoid large gaps between increments, twenty-seven speed changes are provided. These changes are obtained by means of a single lever in combination with the large direct-reading dial shown in Fig. 3. The figures on the dial can be read at distances of from 40 to 50 feet.

The spindle is mounted in three bearings, spaced approximately equal distances apart. Greatly increased stiffness is claimed for this construction without undue load on the bearings. The bearings are spaced far enough apart to allow sufficient endwise expansion to relieve radial expansion. The front and center bearings take both radial and thrust loads, while the rear bearing takes radial loads only.

Twenty-seven feed changes are also provided. All changes are made by means of a lever and dial located on the front of the knee. This dial is somewhat similar to the speed-change dial illustrated in Fig. 3, with the exception that various rates of feed, in inches per minute, are given in the divisions of the dial instead of in revolutions per minute. The dial can easily be read at a distance of between 20 and 30 feet.

The knee resembles an H-type box column with enclosed walls and heavy projections at the bottom of each side in the form of sponsons. Increased stability is claimed for this design. Since the knee is completely enclosed, flooded lubrication is possible for the gears and bearings. The saddle is provided with a large center rib which gives maximum strength without excessive height between the top of the knee and the top of the table.

The center arbor support is hinged in two halves. Each of these halves is bored to fit one of the over-arms, and they are constructed to lock together. When it is desired to remove an arbor with its cutters, each half of the arbor support is merely swung on its over-arm. This feature preserves the original cutter spacings and enables cutters to be set up on a spare arbor for use on the next job.

An important point in the column design is the mounting of the motor at right angles to the spindle. This arrangement not only makes the motor accessible from both ends, but also strengthens the column. Multiple V-belts connect the motor to the driving pulley. As shown in Fig. 4, the driving pulley is of fan construction. It draws air through the louvers on one side of the column and forces it past the motor and out through louvers in the door of the other side.

All models of these machines are provided with rapid traverse in six directions. Engagement of the rapid traverse does not disengage the feed, and when the handle is released, the feed automatically picks up where the rapid traverse ends. As a safety measure, when the rapid traverse is used to run work up to the cutter, the table dog releases the clutch, and the feed is then re-engaged by the reverse lever.

Automatic flooded lubrication is supplied to all gears, shafts, and internal mechanisms. A reservoir for cutting coolant is contained in the machine base, from which it is delivered to the work and cutters by a pump that is accessible when the pulley guard door is open.

The plain milling machines

Fig. 3. Speed-change Dial and Lever

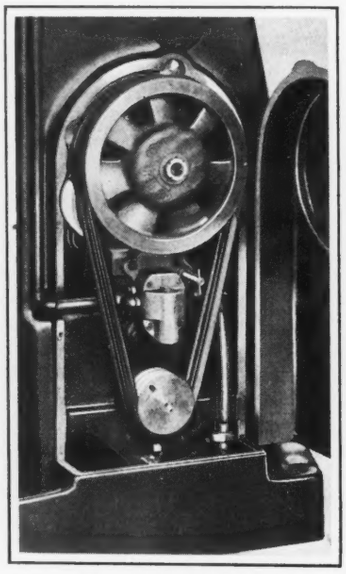


Fig. 4. Driving Pulley of Fan Construction

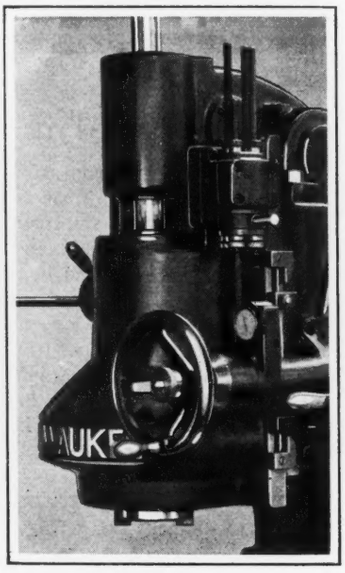


Fig. 5. Sliding Head of Vertical Machine

are the same as the universal type shown in Fig. 1, with the exception that the saddle does not swivel. The manufacturing type illustrated in Fig. 2 is a simplified plain machine in which the speed and feed changes are obtained by means of pick-off gears. Twenty-four speed changes cover the same range as the quick-change mechanism of the plain and universal types. The feed range is covered by eight pick-off gears which provide twenty-four changes, covering the same range as the plain and universal machines.

The sliding-head vertical machine shown in the heading illustration has 6 inches of vertical travel. It can be furnished with a power feed and rapid traverse to the sliding head. The four-step, dial-indicator precision stop seen in Fig. 5 enables step milling to be done with high accuracy. Assuming that three or four surfaces are to be milled at heights in accurate relation to each other, the slide is raised by means of the rapid traverse to a height determined by one of the trip blocks. It is then lowered by the rapid traverse and tripped out by one of the screws on the precision stop. The handwheel is then used to lower the head a few thousandths of an inch until the dial indicates zero.

The new dividing head gives leads for cutting threads as fine as 38 per inch, as well as leads over 2900 inches in one turn. Three sets of pick-off reversible worms and gears give over 40,000 leads, many of which vary as little as 0.0001 inch. Circular milling can be performed, since the dividing head spindle can be revolved by power without engaging the table screw.

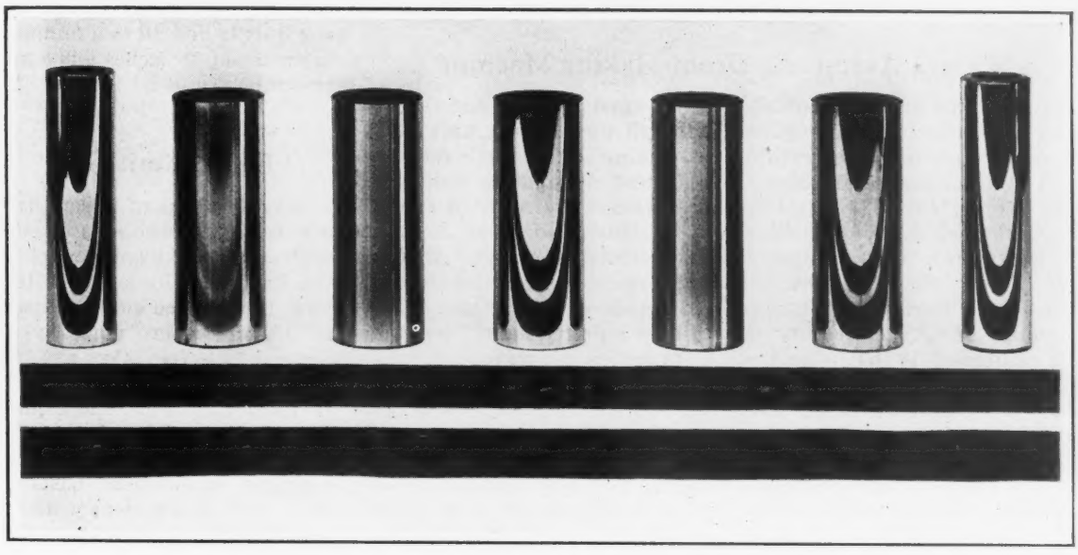
A thread-milling attachment permits the milling of threads from 38 down to 1 per inch, as well as 11 1/2 threads per inch.

Carborundum Grinding Wheels for Unusually High Finishes

The Caborundum Company, Niagara Falls, N. Y., announces the production of solid grinding wheels capable of producing the high finishes ordinarily obtained by burnishing or by lapping with compound or any loose-grain abrasive. The development of these wheels first necessitated the production of uniform grains or grits in the finest sizes. Both Aloxite Brand aluminum oxide and Carborundum Brand silicon-carbide are used, depending upon the character of the material to be ground or finished. The finest of impalpable powders are produced in the Carborundum laboratories for these wheels. These powders are so fine that they literally flow, and yet they have the power to cut clean and fast. The problem of bonding such extremely fine powders into a solid wheel also called for the development of a special bond.

The new grinding wheels are not intended for production grinding in the sense of removing large amounts of metal. Their job is to produce the final luster or finish after a series of progressively finer wheels has been used for removing diminishing amounts of stock in order to prepare the surface for the final finish. The amount of metal to be removed by the finishing wheels depends upon the scratches or wheel marks left by the previous wheels. The finer the surface given by the preliminary wheels, the quicker the ultimate finish is obtained and the less wear on the final wheel.

Varied fields are open for the



Steel Pins, the Different Ground Finishes of which are Indicated by Reflections of Blueprint Strips—Ground on a Cincinnati Centerless Grinding Machine

new wheels. They can be used for finishing piston-pins, bearings, bearing raceways, and various types of rolls used in the metal and textile trades. To get best results from these wheels, it is necessary to use grinding machines maintained in first-class running order to eliminate vibration.

An unretouched photograph showing steel pins with various types of finish is reproduced in the accompanying illustration. In order to compare the finishes, the photograph was taken with two strips of blueprint paper lying in front of the pins so as to be reflected by the surfaces. The pins at the extreme right- and left-hand ends, as well as the one in the middle, were ground with the new type of finishing wheel. The sixth pin from the left has the highest finish said to be heretofore obtainable with grinding wheels, while the second, third, and fifth pins from the left have what are termed as Nos. 1, 2, and 3 finishes.

It will be noted that on two of the pins there is no reflection whatever of the blueprint strips and that the second pin from the left shows just a faint reflection. The two pins on the ends and the one in the center, all of which were ground with the new type of finishing wheel, give almost perfect reflections.

Niagara Automatic Drum-Making Machine

Steel drums are automatically flanged, beaded, and corrugated in a four-unit machine recently built by the Niagara Machine & Tool Works, 637-697 Northland Ave., Buffalo, N. Y. The illustration shows this equipment installed at the plant of the Atlas Steel Barrel Corporation, Bayonne, N. J. A feature of this equipment is that after one unit has expanded the rolling beads, a second unit rerolls them to their final shape and height.

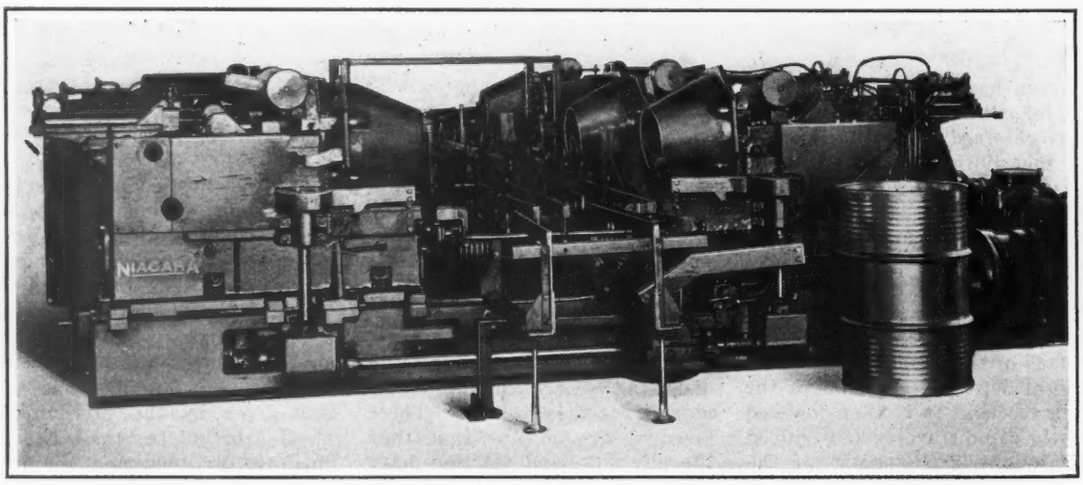
In the illustration, the equipment is shown from the finishing end. Starting at the other end, the welded body shell is placed on a reciprocating conveyor and passes successively through the flanging unit, bead-expanding unit, bead rerolling unit, and corrugating unit. The first two units were described and illustrated in January MACHINERY, page 388. All four units operate simultaneously on both ends of the drums, maintaining a production of five complete bodies per minute.

All the motions of the four units, with the exception of the rotation of the rolls, are produced by means of hydraulic equipment. The hydraulic pumps are of a high-pressure type, with automatic control. Each unit of the equipment is operated by two motors, one for driving the rolls and another for driving the hydraulic pump.

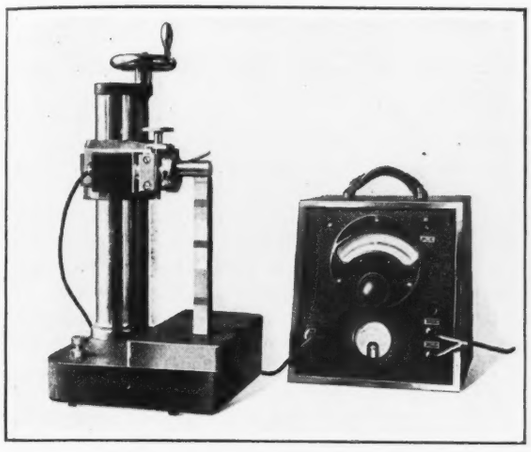
Should a drum body of under-sized diameter or under-sized length enter the machine, the first unit will stop automatically. The subsequent units will continue operating until the remaining drums in the machine have been completed, after which they also will stop automatically. It is possible to "cut out" any of the units so that the drum will pass through that unit without being worked on. Drums from 9 1/2 to 24 inches in diameter and from 14 to 42 inches in length can be accommodated. Since rolling beads are not used on small drums, the bead expanding unit is limited to a minimum diameter of 18 inches and a minimum length of 24 inches.

Electrolimit Gage

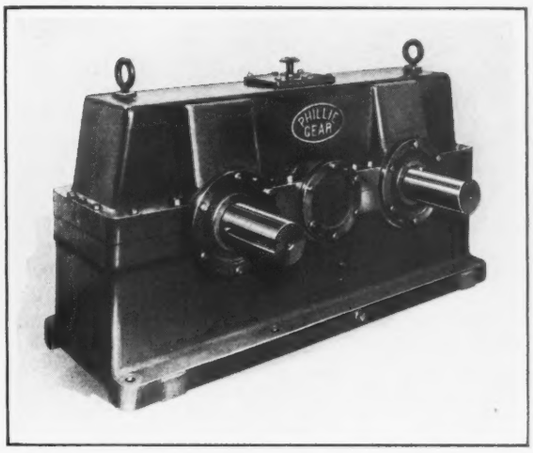
Magnification of errors from 500 to 10,000 times is possible with an electric gage now sold by the Pratt & Whitney Co., Hartford, Conn. The electrical parts of this device are made by the General Electric Co. and the other parts by the Pratt & Whitney Co. This Electrolimit gage is a sensitive comparator, suitable for checking work on a quantity production basis to close limits. Previously its use was confined almost exclusively to the laboratory.



Machine Constructed of Four Units that Successively Flange, Bead, Reroll, and Corrugate Steel Drums



Electrolimit Gage which Magnifies Errors from 500 to 10,000 Times



"Phillie Gear" Speed Reducer with Welded Steel Housing

The device consists essentially of a small gaging head which carries a pointer into contact with the work. Any movement of this pointer changes the balance of the electric circuit so that errors from true size are indicated by a needle that travels over the scale of an indicating instrument.

This gage is available for either external or internal work. When it is to be employed for external work, Hoke precision gage-blocks are used in the manner illustrated to set the device to the upper and lower limits. First the low limit is obtained by means of the proper stack of blocks. With the blocks in position under the diamond contact, a simple adjustment is made by means of a wrench to bring the pointer to the desired position on the scale. Then the high limit is set by a second stack of blocks. Skilled men are not required to operate this device, since "feel" is entirely eliminated.

For internal work, two master solid ring gages representing the "Go" and "Not Go" dimensions are used in setting the gage.

Speed Reducers with Welded Steel Housings

Housings welded from rolled steel are now available for all types of speed reducers made by the Philadelphia Gear Works, Erie Ave. and G St., Philadelphia, Pa. These housings are from 75 to 100 per cent stronger than the cast-iron housings previously furnished and are claimed to be indestructible. They guard the reducer parts from breakage in the event that a heavy ingot or beam should be accidentally dropped on the reducer. The illustration shows a typical reduction unit equipped with one of the new housings.

Tangential Attachment for Newark Gear Cutting Machines

An improved tangential attachment has been brought out by the Newark Gear Cutting Machine Co., 69 Prospect St., Newark, N. J., for use on the No. 3 gear-hobbing machine described in MACHINERY, October, 1928, page 143. This tangential attachment is used for generating worm-wheels with a single cutter or fly tool, and it can also be employed for generating large-angle worm-wheels with a tapered hob.

The new attachment is supplied with a universal joint in the feed drive. This construction allows the cutter-spindle to be swiveled, a feature that enables a good bearing to be obtained in generating with a tapered hob. It also permits spur gears to be generated with a fly cutter. Another improvement is that the cutter-bars are of the removable type. This saves time on jobbing work, as it is unnecessary to remove the main spindle bar.

It takes about fifteen minutes to change the machine from a regular hobber to a tangential type of machine. The standard lead and feed gears are used with the tangential attachment and the same formulas are employed for figuring leads for helical gears. This permits the tool or hob to be moved across the blank by means of the rapid traverse without losing the lead, a feature that is particularly handy in taking two cuts or in multiple thread work. Fly cutters and hobs up to 4 1/2 inches outside diameter can be used. The tool can be moved sidewise if it is necessary to take a side cut.

Farrel-Birmingham Improved Power Presses

Improvements have been made in the design of the power presses built by the Farrel-Birmingham Co., Inc., Ansonia, Conn., to provide greater safety of operation, increase production, and reduce operating and maintenance costs. Anti-friction bearings are incorporated as standard equipment for the drive shaft of all the geared presses. Whenever conditions permit, a

bearing of this type is placed on each side of the main pinions to provide a more uniform bearing of the pinion teeth on those of the gear, as well as to reduce friction.

Another feature of these presses is a multiple-disk friction clutch with a magnetic control and magnetic brake. There is a push-button control with start and stop buttons for one or more operators at as many points as may be desired. A rheostat may be used in series with the magnet to control the clutch to a given horsepower. This feature is a direct protection against breakage of press parts due to overloading and provides added safety to the operator.

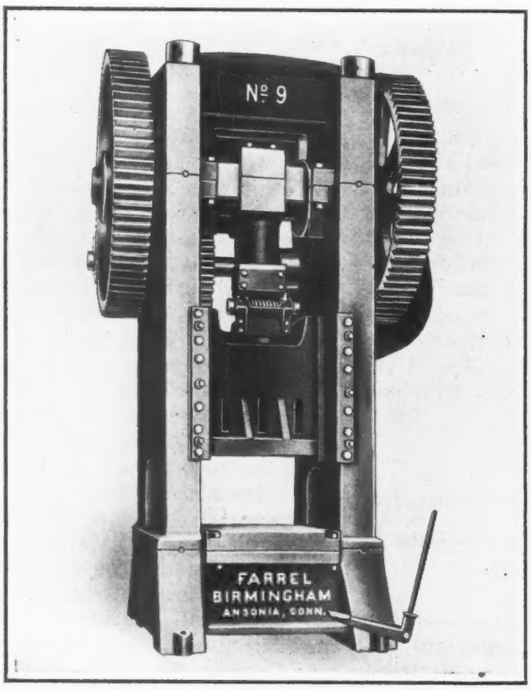
A selector switch and "inching" control enable the operator to run the presses either continuously or a stroke at a time, or to "inch" the presses for special working conditions or for setting dies. By means of stop buttons, the press can be stopped immediately at any point of the stroke.

Niagara Press with Two-Increment Roll Feed

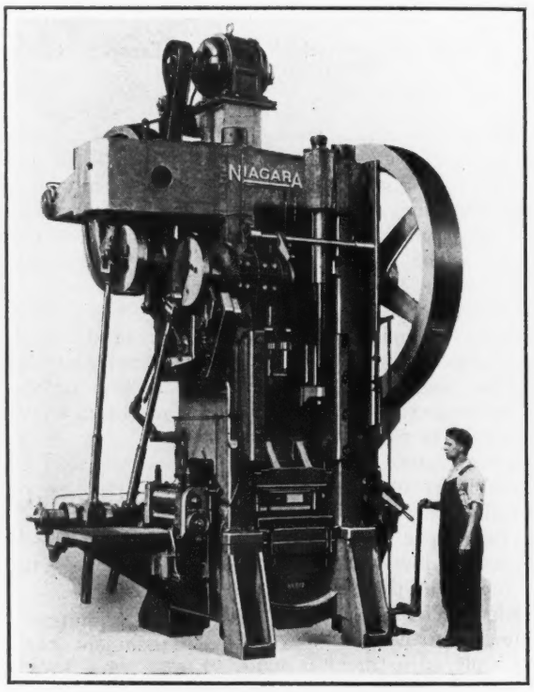
A large single-crank press recently built by the Niagara Machine & Tool Works, 637-697 Northland Ave., Buffalo, N. Y., required a special two-increment roll feed. This press is to be used for punching a predetermined number of groups of holes in strip stock. The distance between the groups must be uniform, but the space between the last group and the end of the sheet is greater. This necessitated an automatic change in the feed from the standard increment to a longer one after the last stroke.

The strip stock is of considerable width and is previously cut to the proper length. It is inserted between the roll feed and through the opening in the press housing at the right after which the operator engages the clutch. The press, die, and roll feed then automatically produce the required number of perforations, and, finally, the long feed comes into action, leaving the broad unpunched area at the end of the strip. The press stops automatically.

This press is single-geared and operates at forty-two strokes per minute. The motion of the slide is controlled by a full-automatic multiple-disk friction clutch, which can be operated by hand or foot. This friction clutch is built into the flywheel, the latter being equipped with anti-friction bearings and mounted on the drive shaft. A brake is automatically released when the clutch is engaged and is applied to stop the machine when the clutch is disengaged.



Farrel-Birmingham Press with Magnetic Control and Magnetic Brake



Niagara Large Single-crank Press Provided with Special Roll Feed

Radial Drills with "Twin Disc" Clutches

The "Low Hung Drive" radial drilling machines built by the Western Machine Tool Works, Holland, Mich., which were described in February, 1930, MACHINERY, page 487, are now equipped with "Twin Disc" clutches. With these clutches,

the entire operation of the machine is controlled by a single lever. Smooth engagement and release are other advantages. Timken tapered roller bearings are provided throughout the machine.

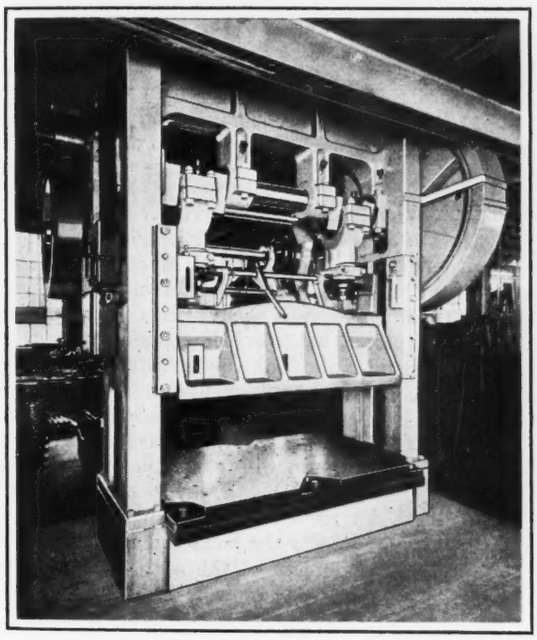
Reversible Press for Trying out Dies

A reversible press has been developed by Williams, White & Co., Moline, Ill., for trying out dies in die shops. This press, as shown in the illustration, is of a straight-sided, double-crank, double-geared, tie-rod construction. Two friction clutches, one forward and one reverse, are mounted on the flywheel shaft. The forward driving clutch is connected directly to a gear on the intermediate shaft, while the reverse clutch is geared through an idler pinion to a second gear on the intermediate shaft.

Both clutches are controlled by a single lever. When this lever is in the central position, a brake is automatically applied. When the press is in normal operation, that is, with the forward clutch engaged, it operates at a speed of seventeen strokes per minute.

The advantages of this press in trying out dies are, first, that the slide can be brought to a stop or reversed at any point in its stroke; and, second, that, after the dies are once fitted, a thorough production test can be made on the machine.

While the press shown in the illustration has an 8-inch stroke, a shut height of 26 inches, and a slide adjustment of 4 inches, machines of this type are built in all sizes with 3 1/2-inch diameter shafts and up.



Reversible Press on which Dies can be Tried Out and also Given Production Tests

Hanna Single-Purpose Riveters

Two single-purpose riveting machines have recently been developed by the Hanna Engineering Works, 1765 Elston Ave., Chicago, Ill., as shown in the accompanying illustrations. These machines are designed for fabricating steel wheels for agricultural equipment. In building up these wheels, the machine shown in Fig. 1 is used first. It drives simultaneously two cold rivets of 3/8-inch diameter for attaching the spokes to the rim. A pressure of 50 tons is applied on the duplex dies.

Before each stroke of the rivet dies, the riveter jaw must enter between two spokes and drop behind the rim flange. To accomplish this, the wheel is rotated and moved to and from the riveter while the jaw moves up and down. A roller nest truck provides for easy wheel movement, while a pneumatic jack swings the riveter on trunnions to produce the vertical jaw movements. The jack is controlled by a poppet valve, and the rivet dies by a heel-operated valve on the floor.

The riveting machine illustrated in Fig. 2 is used next for attaching the spokes to the hub. Before each stroke of the rivet dies on this machine, the riveter jaw must enter into one of the enclosures bounded by the rim, two spokes, and the hub of the wheel. The wheel must then be

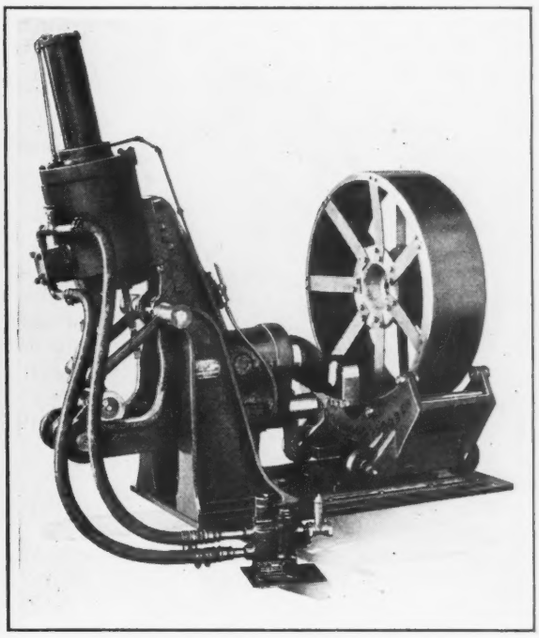


Fig. 1. Hanna Riveter Designed for Fastening the Spokes of Steel Wheels to the Rim

moved toward the riveter, so that the jaw can hook in behind or above the hub flange. All these movements are provided for by a carriage on which the wheel lies flat. The wheel is rotated on this carriage to bring the enclosures or openings around to the riveter jaw. An air jack incorporated in the carriage moves the wheel up and down as required. The carriage is moved horizontally on its stationary stand by a bell-crank handle.

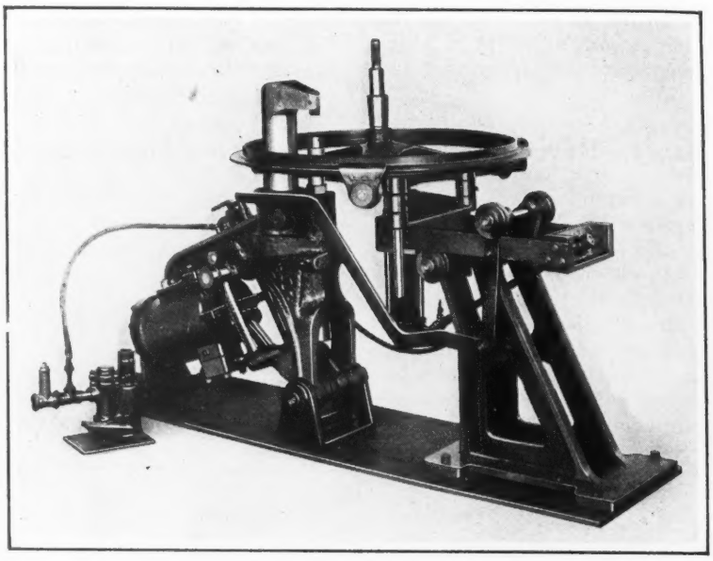
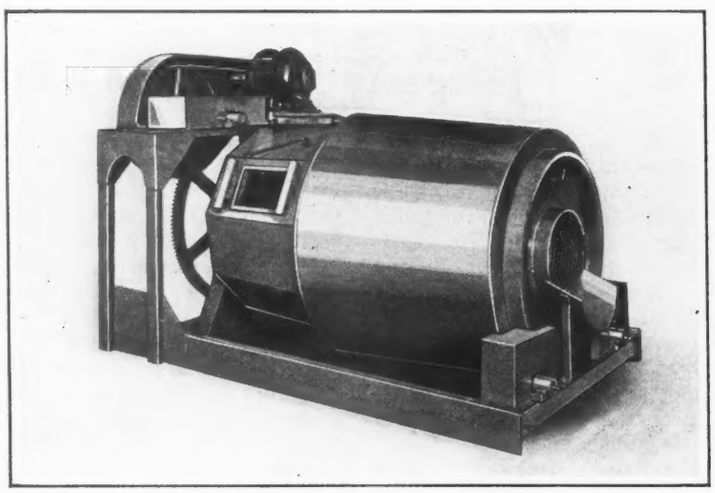


Fig. 2. Riveting Machine Used in Conjunction with Machine Shown in Fig. 1 for Attaching the Wheel Spokes to the Hub

Ransohoff Burnishing Barrel

The burnishing barrel illustrated has recently been added to the line of burnishing, plating, and metal-cleaning equipment built by N. Ransohoff, Inc., Cincinnati, Ohio. The barrel is loaded through a door in the periphery. When the operation is completed, the barrel is rotated in the opposite direction to that in which it runs during the operation, the reversal causing the work to be automatically discharged through the screen in the center of the barrel. The work comes out at the end, while the balls pass through perforations in the screen and are retained in the cone surrounding the screen.

As soon as the work is discharged, the barrel is reloaded and the door is bolted shut. When the barrel is again run in the burnishing direction, the balls return automatically to the burnishing compartment. Rehandling of the balls is thus eliminated. Reversal of the barrel rotation is obtained by means of a reversing switch on the motor.



Ransohoff Burnishing Barrel that Does Not Require Handling of the Balls

Lincoln Electrodes

An electrode suitable for building up worn manganese steel castings has been developed by the Lincoln Electric Co., Cleveland, Ohio. This new electrode is known as "Manganweld." It has a heavy extruded coating that provides a shielded arc, thus allowing the transfer of metal to take place under non-oxidizing conditions. The coating also insures minimum arc disturbance and boiling in the crater, and provides a layer of easily removed slag which further protects the weld from the harmful effects of the air.

Manganweld electrodes are 11 to 15 per cent manganese steel. The weld is "air-toughening," eliminating the necessity of quenching the bead.

The same concern has also developed a "Hardweld" electrode containing about 1 per cent carbon. It is recommended for use in building up cupped or worn rails, locomotive tire flanges, car wheels, dies, and other parts. A special coating is said to eliminate the difficulties usually met with in welding with high-carbon electrodes.

The weld produced has a tough dense surface of moderate hardness and will resist wear and abrasion. The special coating regulates the analysis of the deposit by controlling oxidation and variations in the arc length.

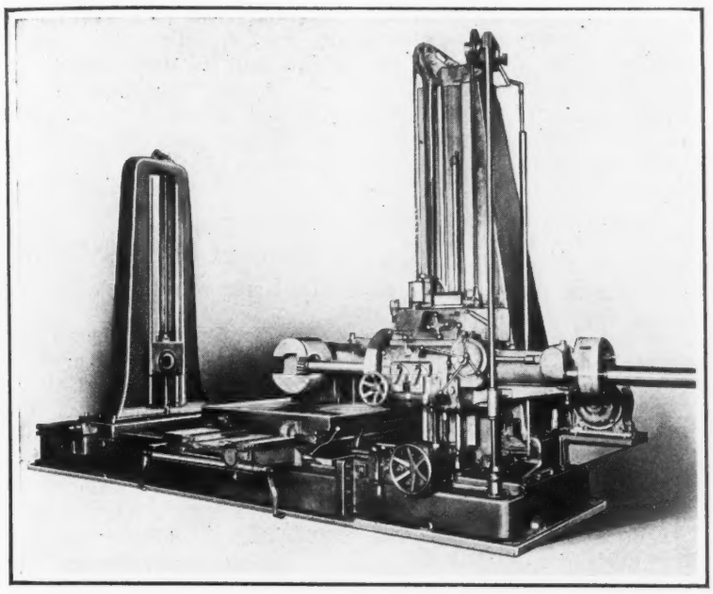


Fig. 1. Large Boring, Drilling, and Milling Machine Developed by Joseph T. Ryerson & Son, Inc., and the Ohio Machine Tool Co.

Ohio Large-Sized Horizontal Boring, Drilling, and Milling Machine

A special horizontal boring, drilling, and milling machine with a table working surface of 60 by 96 inches and a cross-feed of 94 inches has recently been developed by Joseph T. Ryerson & Son, Inc., Chicago, Ill., in conjunction with the Ohio Machine Tool Co., Kenton, Ohio. The weight of this machine is 60,000 pounds. It is equipped with a spindle 5 inches in diameter having a continuous feed of 36 inches. The maximum distance from the top of the table to the center of the spindle is 85 1/2 inches, while the maximum distance from the faceplate to the bar support is 14 feet.

Eighteen speeds, all reversible, are obtainable, as well as eight boring and drilling feeds and sixteen milling feeds to the head, table, and saddle. The feeds are also reversible. They are not affected by the drive back-gears, as they receive their primary drive from the spindle.

The machine is equipped with a 60-inch power- and hand-driven revolving table which receives its power feed and rapid traverse from the feed-shaft in the bed, as may be seen from Fig. 2. The machine is also equipped with a thread-chasing attachment operated directly from the spindle. Any number of threads per inch can be cut.

The feeding and driving mechanism for the spindle is contained in the head. All controls may be operated from the head, with the exception of the directional control levers for the table and saddle. The controls for the motor are operated from the head and also from the floor. A hand quick-traverse of the spindle can be obtained by rotating the turnstile located close to the faceplate. The handwheel near the faceplate is employed to move the spindle in or out, the head up or down, the platen crosswise, and the platen saddle lengthwise. The large handwheel on the bed likewise provides for moving all units, with the exception of the spindle, by hand. There is a rapid traverse of the selective type for all units.

The various sliding members of the machine are equipped with guides of the square-lock type. Tapered gibs are provided their entire length to resist wear. The table is guided on a bed 54 inches wide over all. The feed-screw is directly under the center of the spindle at all times, an arrangement that is particularly useful in boring holes by employing the regular feed to the spindle. Power for driving the machine is furnished by a 20-horsepower, constant-speed motor of the reversible type.

Oliver Motor-Driven Pattern-Shop Sander

Two disks, 37 inches in diameter, are provided on a large-sized motor-driven disk sander

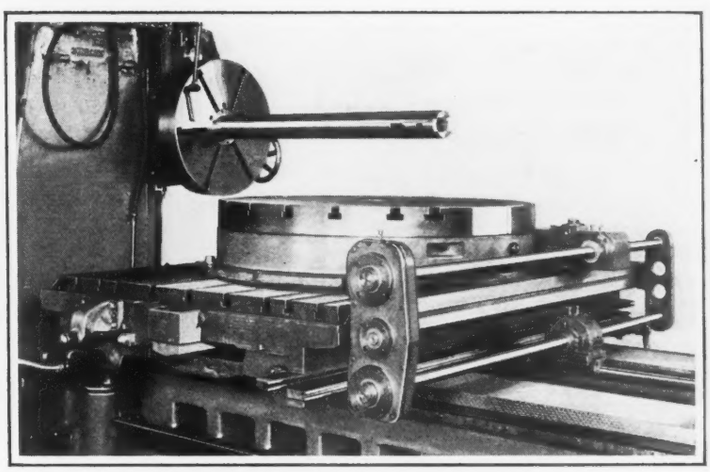
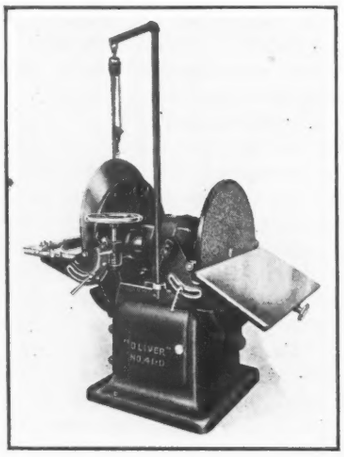


Fig. 2. Sixty-inch Power- and Hand-driven Revolving Table Furnished for the Machine Shown in Fig. 1



Oliver Pattern-shop Sander with 37-inch Disks

which is built by the Oliver Machinery Co., Grand Rapids, Mich., primarily for pattern-shop service. Devices are furnished with this equipment for duplicating work and for circular sanding. Hoods surround the sanding disks to carry the dust to the exhaust and to protect the operator.

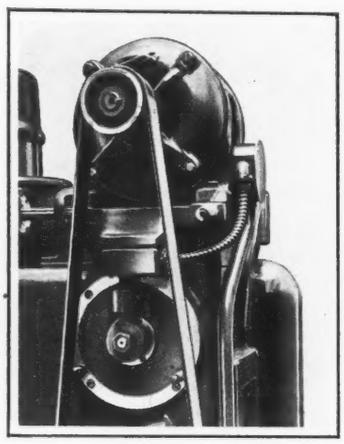
A hoist which comprises part of the machine facilitates the changing or mounting of disks. Garnet or other abrasive sheets are cemented to the metal disks. They are easily replaced when worn. The motor is of 7 1/2 horsepower rating, and runs at 900 revolutions per minute. It is equipped with Timken roller bearings.

Automatic Electrical Control for Fellows Gear Shapers

Motor-driven, high-speed gear shapers built by the Fellows Gear Shaper Co., Springfield, Vt., are now provided with an automatic electrical control. A push-button station with "start" and "stop" buttons is mounted on an auxiliary bracket of these machines. The machine can be stopped at any point in its cycle by merely pushing the "stop" button. This is very convenient in setting up for new operations.

The machine is stopped automatically as each complete cycle is finished by the use of an electrical control switch attached to an extension on the rear of the motor bracket. This switch is operated by a plunger, as shown in the illustration. The plunger, in turn, is actuated by a cam mounted on the same shaft as the regular feed-cam, and it is timed with the latter.

When the roll on the saddle-operating rack reaches the high point on the feed-cam, and just before it drops into the depression, the switch-operating cam



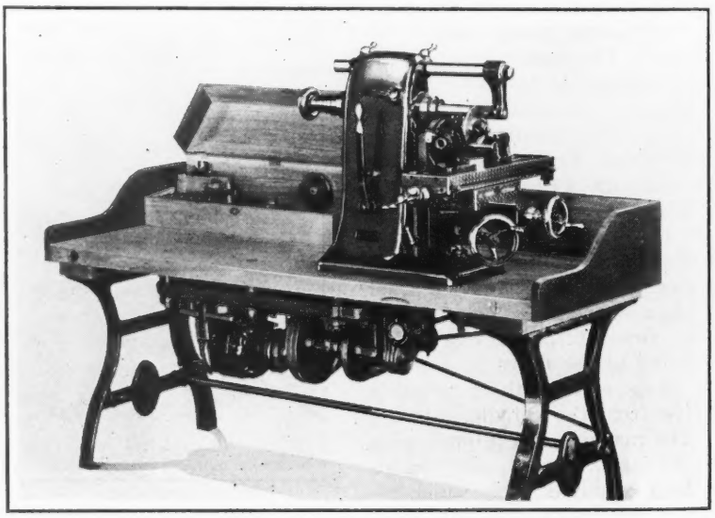
Cam-operated Electrical Control on Fellows Gear Shaper

lifts the plunger to break the circuit and stop the machine. Then, when the roll drops into the depression on the feed-cam, allowing the saddle to return to its back position, the plunger drops into the depression on the control cam. This closes the circuit and allows the machine to be started again by depressing the "start" button.

Cataract Bench Milling Machine with New Drive

The No. 5 Cataract bench milling machine manufactured by Hardinge Bros., Inc., Chicago, Ill., is shown in the illustration equipped with the V-belt, under-bench transmission that has hitherto been used on the motor-driven bench lathe and the No. 4 motor-driven milling machine built by the same concern. Six speeds ranging from 160 to 1400 revolutions per minute, forward or reverse, are obtained with this drive. A box at the back of the bench holds the various attachments and collets used with the machine.

Some of the important specifications of the machine are as follows: Collet capacity of cutter-head, 1 inch; working surface of table, 20 by 6 inches; longitudinal movement of table, 1 inch; transverse and vertical movements of table, 6 1/2 inches; weight of machine, alone, 340 pounds; and weight of bench with transmission, 487 pounds less the motor.



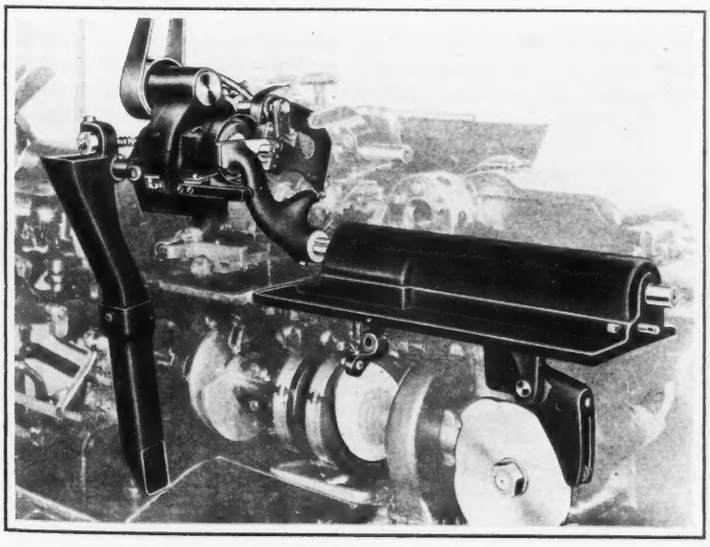
Cataract Milling Machine with Under-bench Transmission

Brown & Sharpe Nut-Tapping Attachment

The nut-tapping attachment here illustrated has recently been added to the screw machine equipment of the Brown & Sharpe Mfg. Co., Providence, R. I. This attachment is made in three sizes for use on the Nos. 00, 0, and 2 machines. It can be used on both the regular and high-speed machines, as well as on the screw-threading machines. The attachment is of the second-operation type and is fastened to the machine above the front cross-slide.

An arm takes the part after it has been cut off at the main spindle of the machine, carries it to the intermediate position, where a countersinking operation is performed on the back end, and then transfers it to the tapping unit proper. Here the nut is placed in a revolving chuck and is automatically fed over a bent-shank tap, finally dropping into a chute which leads to a work-pan. As the nuts are fed along the shank, they bear on two bushings and hold the tap in position.

On belt-driven machines, the attachment is driven from overhead or by an attachment driving stand, while on motor-driven machines, power is furnished by a separate motor.



Nut-tapping Attachment for Brown & Sharpe Screw Machines

Buffalo Interchangeable Coper and Notcher

"Armor-Plate" universal "Iron Workers," built by the Buffalo Forge Co., Buffalo, N. Y., may now be provided with interchangeable built-in 90-degree notching and square-coping tools for the shear end. This arrangement provides for using the notcher on the shear end in shops that operate the punch end more extensively than the bar-cutter and shear sections. The notcher can also be provided on the punch end, but the coper is applicable to the shear end only.

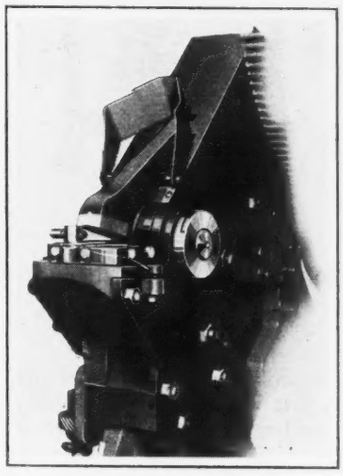


Fig. 1. Buffalo Square Coper Interchangeable with Notcher

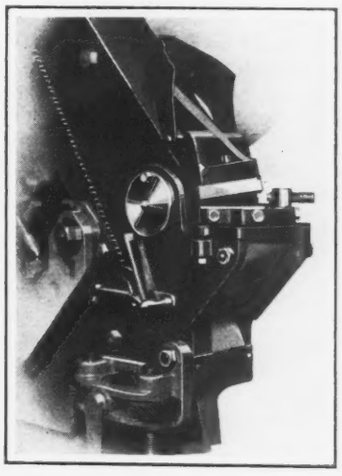


Fig. 2. Notcher for Either Shear or Punch End

These new notchers and copers are of an improved design. The two supports for the dies are welded to the frames and do not depend on studs to carry the load. Because of this construction, it has been possible to keep the size of the die supports down to a minimum, which means less interference with the operator's vision when the slitting shear is being used.

The notcher will also cope the ends of I-beams and channel irons (flanges only) or angle- and T-irons square, if the material is inserted diagonally and suitable stops are provided. The material is fed into the dies without tilting, making it easy for the operator to cut on the line.

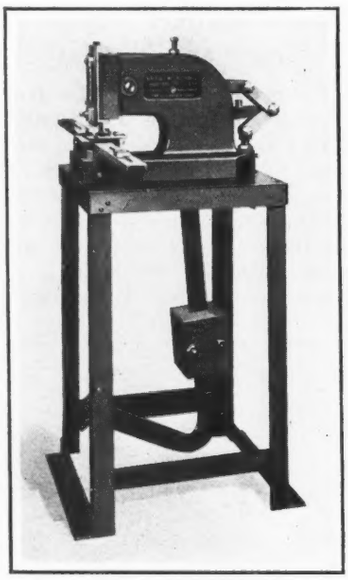
Whitney Toggle-Lever Foot Press

The No. 28 toggle-lever foot press recently developed by the Whitney Metal Tool Co., 751 Race St., Rockford, Ill., has a capacity for punching 2-inch holes through No. 16 gage material. It has a throat depth of 7 inches, a throat height of 4 inches, a slug clearance hole of 2 1/4 by 4 1/4 inches, and a ram stroke of 1 inch.

Six laminated, hardened and ground tool-steel plates provide

means of taking up wear. These laminated disks can also be used to adjust the stroke position of the ram 1/2 inch up or down. The bolster plate is provided with a T-slot for attaching stops or stripper plates. The foot-pedal is adjustable.

The machine is equipped with a material support, and there are adjustable stops on each side. Depth gage holes are also drilled or tapped on each side of the head for locating stripper fingers. It is stated that about 100 holes per minute can be produced on this machine.



Whitney Foot Press with Laminated Disks for Taking up Wear

Brown & Sharpe Adapters, Arbors, and End-Mills

Cutter adapters of new designs, as well as screw arbors, spiral two-lipped end-mills, and arbors for shell end-mills for use with these adapters, are being placed on the market by the Brown & Sharpe Mfg. Co., Providence, R. I. The cutter adapters are furnished in two different styles for use on milling machines having standardized spindle ends. One of these styles is illustrated at *A* and the other at *B*. They are similar in construction, with the exception that the distance from the back of the driving collar to the front end of the taper hole is considerably shorter in one than in the other. The style *C* adapter is designed for use on milling machines having tapered- or threaded-nose spindles.

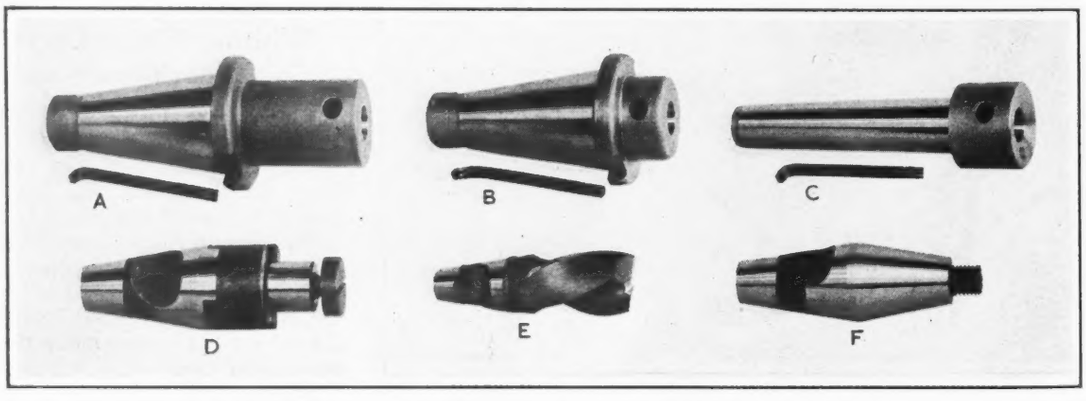
These adapters have a standard milling-machine taper hole to suit the shank of end-mill *E* or arbors *D* and *F*. Screw arbor *F* is intended for adapters having a No. 30 milling machine taper hole. The mill and the arbors are held securely to their seats by means of a cam, thus providing a positive drive. The cam engages the flat surface of the groove in the shank of the cutter or arbor. When the cam is turned for releasing, the cutter or arbor drops from the adapter. The steep taper prevents striking and insures a quick release. These adapters, arbors, and end-mills are available in a range of sizes.

Societe Genevoise Precision Microscope

The micrometer microscope here illustrated is intended for the accurate checking of small parts or for precision measurements on standard scales and circular divisions. It has been brought out by the Societe Genevoise d'Instruments de Physique and is being placed on the American market by the R. Y. Ferner Co., 1135 Investment Bldg., Washington, D. C. This microscope can be used for checking the profiles of small gears or screw threads, or for measuring fine wires, diamond dies, and similar parts.

The thrust bearing of the micrometer screw is a sapphire ground optically flat to eliminate periodic errors and insure accurate results. A counteracting spring eliminates any play. A new white material used for the graduated surface gives a matt which makes the reading of the drum free from eye strain. The drum is accurately graduated on a circular dividing machine. Accurate estimates of tenths of a division can be readily made, a tenth of a division amounting to 0.000005 inch on instruments graduated in inches or 0.0001 millimeter on metric microscopes.

The eye-piece is mounted on a small carriage which slides in the top of the micrometer box under the action of a rack and pinion. This permits of placing the eye-piece over the center of the part in the field in which the



Brown & Sharpe Cutter Adapters, Arbors, and Two-lipped End-mill

measurements are made so as to reduce any distortion of the image after the primary correction by the achromatic lenses.

A feature of this microscope is that it can be dismantled without danger of losing the original calibration. The instrument is made in three models, having magnifications of 41.5X, 63X, and 96X.

Sundstrand Balancing Equipment

Equipment for balancing light-weight parts such as aluminum fans, motor armatures, etc., has been added to the line of balancing tools built by the Sundstrand Machine Tool Co., Rockford, Ill. The accurately balanced knife-edge steel disks of this "Super Sensitive" balancing tool are mounted on hardened steel spindles which revolve on steel balls enclosed in races of a special design. This construction is unusually sensitive due to the fact that the spindle has a direct pivoting action on the ball bearings. The equipment is portable, and the design is such that leveling is not necessary.

The manufacturer claims that the sensitivity of the equipment is such that a 1 1/2-pound disk can be thrown out of balance with a 5-grain weight on a 3-inch radius. The important specifications of the equipment include the following: Swing, 22 inches; maximum distance between standards, 20 inches; and capacity, 12 pounds.

Societe Genevoise Microscope for Checking Small Screws, Gears, and Other Parts

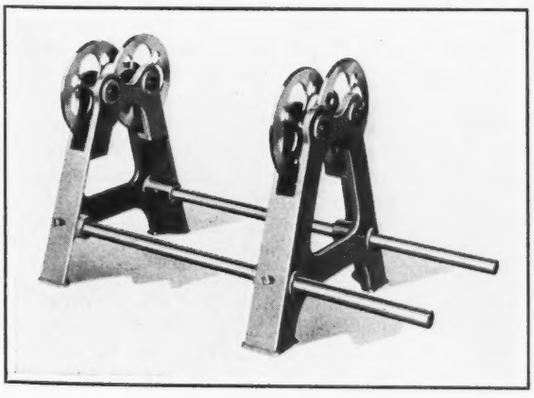
Oilgear High-Pressure Pumps and Constant Displacement Motor

The Type QR-2, one-way variable-delivery pump recently developed by the Oilgear Co., 647-683 Park St., Milwaukee, Wis., has a maximum working pressure of 1500 pounds per square inch. The capacity is variable from 60 to 1650 cubic inches per minute. This pump is a compact, self-contained unit available with several mountings. It can be mounted on a flange for convenient installation in the machine that it is to operate, an oil reservoir being required in that case. The pump can also be furnished with a standard oil casing having mounting feet or with a large combination oil reservoir and base as illustrated, which is intended for use with a direct-connected motor drive.

This pump is designed for use in connection with cylinders and machines performing broaching, assembling, grinding, honing, planing, drilling, boring, and similar operations in which a smooth positive straight-line motion is essential. It is also recommended for use in connection with Oilgear constant-displacement motors to provide variable-speed transmissions.

The same concern has also brought out a Type QWR-2 one-way variable-delivery pump which is similar in construction and operating characteristics to the QR-2 pump. However, this type has, in addition, a constant and variable pressure control, the working pressure being adjustable from 500 to 1500 pounds per square inch. This pump is especially intended for use in connection with cylinders and machines performing assembling, squeezing, clamping, riveting, and similar processes in which it is necessary to hold the work under a predetermined pressure for a period of time. It is also suitable for use with constant-displacement motors.

Fig. 2 shows a Type RQ-2 constant-displacement motor which has also recently been added to the line of hydraulic equipment built by this concern. When used in combination with a variable-



Sundstrand Balancing Equipment of High Sensitivity for Light-weight Parts

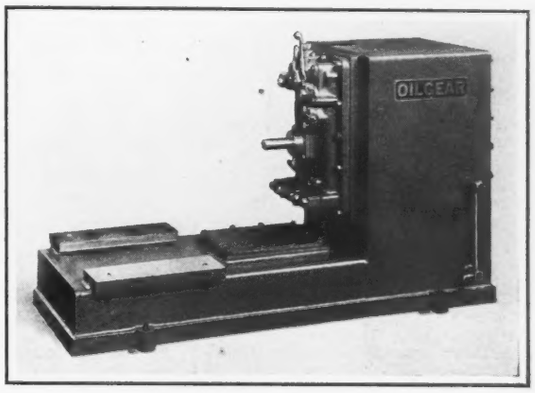


Fig. 1. Oilgear One-way Variable-delivery Pump with Welded Steel Base

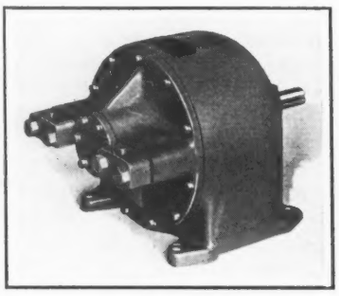


Fig. 2. Constant-displacement Motor for Variable-delivery Pumps

delivery pump, this motor provides a variable-speed transmission suitable for application to conveyors and other machinery. Large grinding machine tables can be reciprocated through a rack and pinion mechanism.

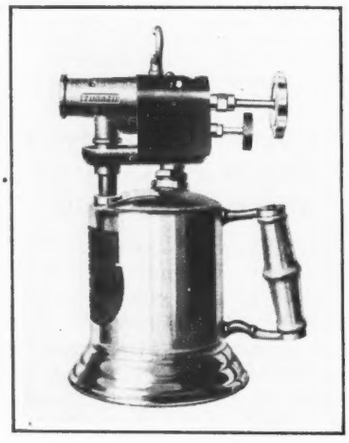
A series of speed ratios practically independent of variations in load are available with such a transmission. Any constant-speed source of power can be used to drive the pump, while the motor shaft can be varied from zero to the maximum, being at all times under the control of a single lever. A speed range from 0 to 800 revolutions per minute is obtainable.

Westinghouse Flex-Arc Welder

An alternating-current arc welding set designed for operation at between 8.5 and 125 amperes has recently been developed by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. This equipment is intended for welding thin-gage material such as is used in the manufacture of metal furniture and in the building of airplanes.

Westinghouse Portable Alternating-current Welder

It may be used in conjunction with either bare or covered electrodes from 1/32 to 1/8 inch in diameter. Many ferrous-alloy materials commonly used with reversed-polarity direct current are effectively employed in conjunction with this welder. It has also proved successful in welding aluminum.

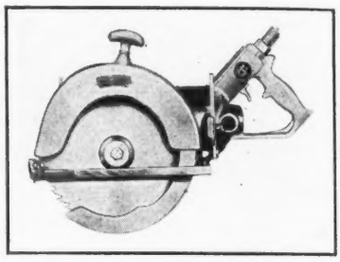


"Blotorch" Designed for Operation in Any Weather

Turner "Blotorch"

The No. 39-A "Blotorch" here illustrated has been designed by the Turner Brass Works, Sycamore, Ill., primarily for professional users. The manufacturer claims that it is impossible to jam the orifice by hard usage, that the blow-torch will operate satisfactorily in any weather, and that it is especially constructed for long wear. The cleaning needle and orifice block can be easily replaced if necessary.

Among the features mentioned is the provision of cold composition valve handles. The drip cup can be conveniently filled through the lower priming valve. The tank of the new "Blotorch" has a capacity of one quart.



Portable Electric Saw Made by the United States Electrical Tool Co.

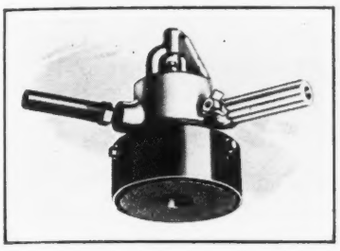
Portable Electric Saw

The portable electric hand saw illustrated was recently placed on the market by the United States Electrical Tool Co., 2477 W. Sixth St., Cincinnati, Ohio. Two adjustments are sufficient for setting this saw quickly for any depth of cut and to any angle up to and including 60 degrees. Top and automatic bottom guards protect the operator in every working position. Ball bearings are provided throughout. This saw is made in different models for taking cuts 1 7/8, 2 5/8, 3 1/16, 3 9/16, and 4 1/8 inches deep. It will cut wood, stone, slate, and other materials.

Multi-Vane Surface Grinder and Sander

A light-weight high-production tool suitable for grinding, sanding, polishing, and wire-brushing operations has been added to the line of Multi-Vane devices made by the Ingersoll-Rand Co., 11 Broadway, New York City. Some of the uses to which this device can be applied are the sanding and polishing of automobile bodies; smoothing down of welds; cleaning and surfacing of large castings for painting; polishing of locomotive side rods; and sanding of metal and wood surfaces.

Two handles are provided on the tool so that the operator can readily hold it at right angles to the work. One can be removed in order to use the equipment in close quarters. The other acts as the air inlet and contains a thumb-controlled throttle valve.



Multi-Vane Portable Tool which can be Employed for Sanding, Polishing, or Grinding

The standard free speed is 4600 revolutions per minute, but units can be furnished for operation at higher or lower speeds. The size 4-F sander illustrated weighs 10 3/4 pounds without the adjustable grinding wheel guard. It has an over-all length of 9 1/4 inches.

Wright Electric Trolley Hoists

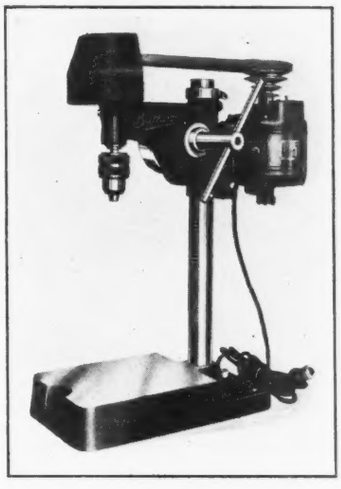
The high-speed electric trolley hoists made by the Wright Mfg. Co., Bridgeport, Conn., which were described in the April number of MACHINERY, may now be provided with trolleys of plain, geared, and motor-driven types. The bearings of the trolley wheels are designed to absorb both radial and thrust loads. In the motor-driven trolleys, the wheels are driven on each side of the I-beam to insure smooth operation. Controls for one, two or variable speeds can be furnished. The hoists can be mounted parallel with or at right angles to the runway beam.

Buffalo Simplex Bench Drill

Four spindle speeds of 855, 1210, 2380, and 3400 revolutions per minute are available on the 13 1/2-inch Simplex bench drill recently brought out by the Buffalo Forge Co., Buffalo, N. Y. The entire head of this drill travels up and down on the column, there being no additional vertical movement of the ball-bearing spindle. As the head can be lowered within about 3 inches of the base, the drill can be conveniently arranged for low work. The maximum distance between the spindle and the base is 14 inches.

The spindle head can be swung to one side so as to use the equipment as a radial drill on large pieces or odd shapes. In fact, the head can be swung completely around the column and locked in any position. Either a 1/6- or a 1/4-horsepower motor can be supplied. The motor is tilted for adjusting the drive belt.

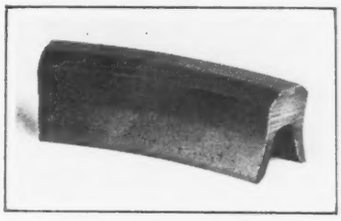
A grinding attachment driven directly from the V-belt can be clamped to the top of the column. A flexible shaft can be driven from the grinding attachment for performing various operations. The net weight of this bench drill is 83 pounds.



Buffalo Bench Drill with Adjustable Head

Rubber Packing for Hydraulic Equipment

The Diamond Rubber Co., Inc., Akron, Ohio, has brought out a new packing material known as "Rubber Crimps," which is intended for service in hydraulic rams and presses. This packing is made in rings of standard sizes with a U-shaped cross-section. The rubber is especially compounded to resist oil, and is covered almost completely by a layer of fabric. This fabric adds considerable strength and helps to maintain a 1/4-inch flare at the bottom of the packing. The flare is particularly advantageous when there are worn or imperfect parts in the ram.

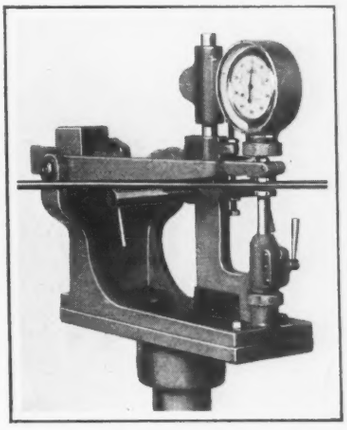


U-shaped Rubber Packing for Hydraulic Equipment, Made by Diamond Rubber Co.

The packing is suitable for pressures up to 3000 pounds per square inch. Other advantages claimed are as follows: The packing is not affected by the heat generated in a hydraulic press; it wears slowly and evenly; it fits snugly against the ram to make an absolute seal; and it will not dry up when a press is idle. It can be furnished in any standard diameter.

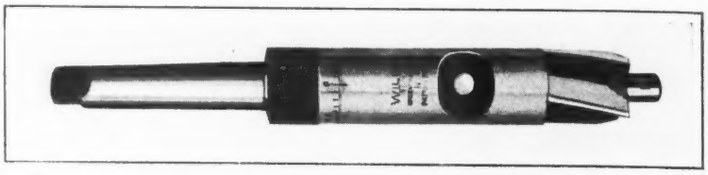
Federal Wire Gage

A wire gage having a range of from 0 to 0.2 inch, which is equipped with a dial indicator graduated to 0.001 inch, has been added to the line of gages made by the Federal Products Corporation, 1144 Eddy St., Providence, R. I. The indicator is enclosed in a dustproof housing. Interchangeable anvils can be supplied in suitable sizes.



Federal Wire Gage which can Easily be Set to Any Size

There is an adjusting screw for setting the gage instantly to any desired size. A safety rocker arm holds the anvils out of contact. The proper tension is maintained through a compensating weight. Guide rollers may be provided if desired.



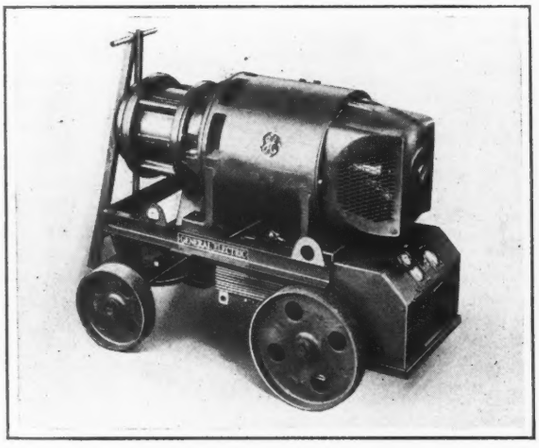
Wilder Quick-change Tool-holder which is Adjustable for Length

Wilder Adjustable-Length Tool-Holder

A quick-change tool-holder that is conveniently adjustable for length, in thousandths of an inch, has been placed on the market by the Wilder Tool Co., Greenfield, Mass. This tool-holder was developed for such multiple-spindle operations as counterboring, core-drilling, countersinking, and hollow milling. It is also intended for use with multiple-diameter, one-operation tools. Tools for such operations are interchangeable in a holder of given size.

The tool-holder is made of alloy steel. It is ground to size and in true alignment. The tools can be guided from the outside diameter of the holder by means of bushings or from the end by hardened and ground removable pilots.

The length adjustment is from 21/32 to 1 3/4 inches, depending upon the length of the holder. To increase the holder length, the graduated knurled barrel is turned clockwise, while to shorten the length, it is revolved counter-clockwise. The settings cannot change while the tool is in action.



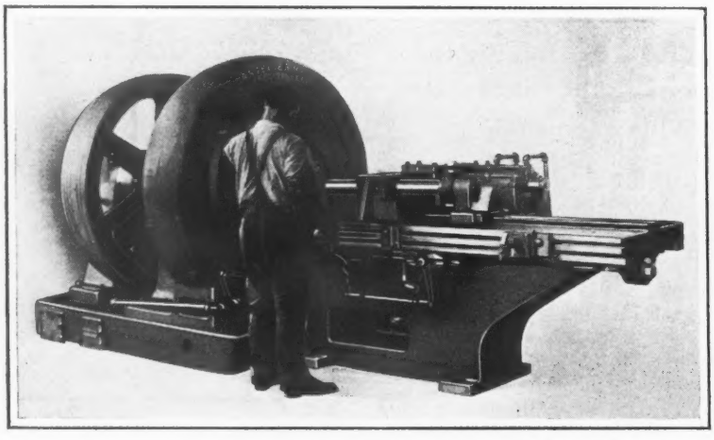
General Electric Portable Type of Improved Welding Set

General Electric Welding Sets

A line of single-operator welding sets incorporating improvements over past designs has been placed on the market by the General Electric Co., Schenectady, N. Y. This line has been designated WD-20, and includes sets with ratings of 100, 200, 300, 400, and 600 amperes.

Portable sets such as illustrated, as well as stationary sets, are included in the line, and they are made for operation on either alternating or direct current of all standard voltages. In the case of alternating-current sets, standard frequencies and two- or three-phase gasoline-engine driven sets will also be available.

One of the new features is a practically instantaneous voltage recovery from short circuit to nearly the full open-circuit voltage. This gives a quickly responsive arc. Another improvement is a duplex voltage control by the operator over a wide range, with the particular provision of a surplus voltage which can be used for long welding leads.



Langelier Swaging Machine with Spindle Mounted in Timken Bearings

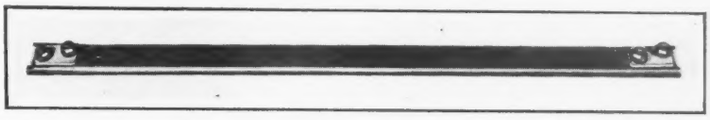
Langelier Swaging Machines

A new line of swaging machines is being introduced on the market by the Langelier Mfg. Co., Providence, R. I., in which the spindle is mounted in Timken bearings. In addition to the advantages of reduced power consumption, decreased friction, and lengthened life of parts, this construction gives close concentricity between the revolving spindle and the circle of head or retainer rolls. These bearings also permit the use of a shorter and more rugged spindle.

Eleven sizes are included in the new line of machines, enabling work from 3/16 to 9 inches in diameter to be handled. The three largest machines of 5, 7, and 9 inches capacity, respectively, can be furnished with plain bearings for the spindle if desired. In this case, however, bronze bushings are supplied in the head and an outboard bearing is provided, with the flywheel mounted between the two.

All the machines of the line are mounted on cabinet-type bases which have a large oil reservoir cast integral with the base. A pump attached to the rear of the base forces the oil to the head for lubricating and cooling the working parts. The lubricant is fed both from the center outward and from the outside toward the center.

The flywheel is of a webbed type and is mounted on the spindle. It also serves as the driven pulley for the machine, the face being finished either with a crown for a flat belt or with grooves for V-belts. Work-holding and feeding mechanisms of various types and sizes for different kinds of work are available.

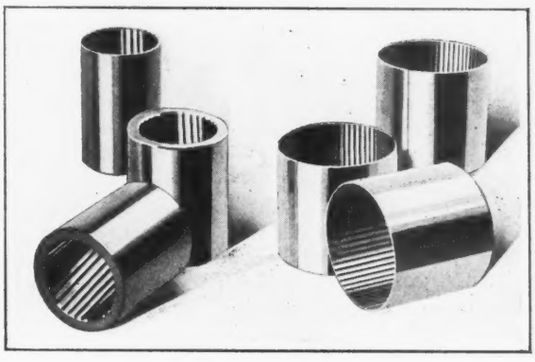


Trent Strip Heater in which Two Electrical Circuits are Insulated from Each Other

Trent Strip Heater

A modified form of strip heater is being manufactured by the Harold E. Trent Co., 618-640 N. 54th St., Philadelphia, Pa., in which there are two complete electrical circuits entirely insulated from each other. Each circuit extends the full length of the unit from terminals at one end to a terminal block at the other end.

This arrangement has a number of applications. It provides, with the convenience of a single strip, a two- or three-phase heater or resistor, or a three-heat unit that is always heated over the full length for one, two, or three heats. This heater is applicable to strip steel drawing furnaces, and is also adapted for heating narrow surfaces and pipe lines where heat regulation is required. It can be made in any length for commercial voltages, and with or without perforated ends for mounting.



Johnson Cast and Sheet-metal Graphite-impregnated Bushings

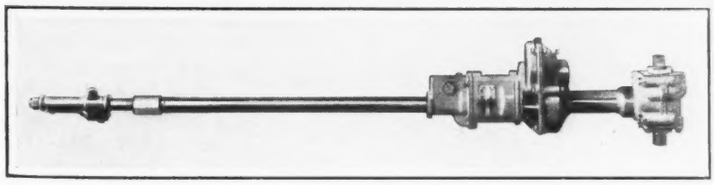
Johnson Self-Lubricating Bushings

Cast phosphor-bronze bushings and rolled sheet-metal bushings, both having dovetailed grooves impregnated with graphite, are being introduced on the market by the Johnson Bronze Co., New Castle, Pa. The grooves of the cast bushings, which are shown at the left in the illustration, are 1/32 inch wide and are cut longitudinally at an angle of 7 degrees. From 40 to 45 per cent of the bearing surface in these bushings is graphite-impregnated. It is stated that this type of bushing has been tested in a fractional-horsepower motor which was run at 17,500 revolutions per minute continuously for 600 hours. At the end of this time, the wear on the bushing and shaft was negligible.

In manufacturing the rolled sheet-metal bushings, shown at the right in the illustration, straight-sided grooves are cut in the strip metal before the bushing is formed into a cylinder. In the forming operation, the grooves automatically assume a dovetailed shape which holds the lubricating compound permanently in place.

Chicago Pneumatic Rotary Wrench

A rotary pneumatic wrench for tightening or removing nuts up to and including 1 1/4 inches in size has been added to the line of tools manufactured by the Chicago Pneumatic Tool Co., 6 E. 44th St., New York City. This tool is especially adapted for removing or tightening flexible staybolt caps, cylinder and valve-chamber head nuts, dome nuts, front end nuts, frame nuts, etc. The sockets are a snap fit on the spindle, assuring quick replacement when a different sized socket is necessary or the

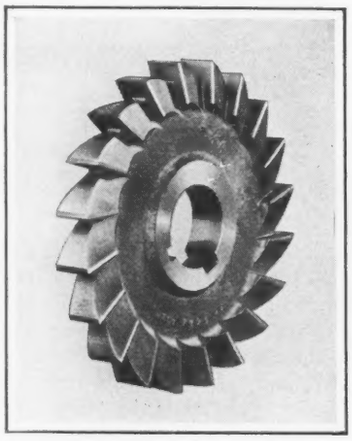


Air-driven Rotary Wrench Brought out by the Chicago Pneumatic Tool Co.

reverse motion is desired. The tool has a light speed of 130 revolutions per minute, an over-all length of 7 7/32 inches, and a weight of 48 pounds.

National-Cleveland Die-Forged Milling Cutters

High-speed steel side-milling cutters forged in dies direct from the billet are being introduced on the market by the National Tool Co., Cleveland, Ohio. These cutters have unfinished web recesses. They are made in all standard sizes from 3 inches outside diameter up. Their design will be apparent from the illustration.



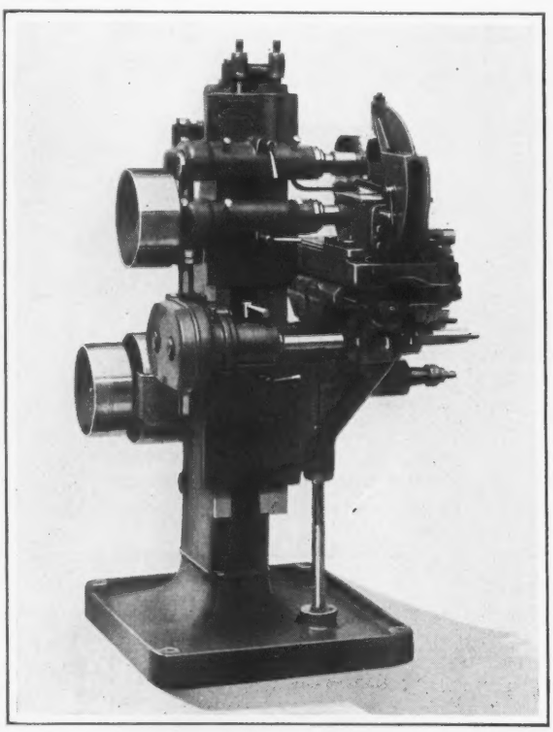
National-Cleveland Die-forged Milling Cutter with Unfinished Web Recesses

Double-Spindle Automatic Milling Machine

A double-spindle automatic milling machine equipped with a special fixture for holding piston-rings while sawing them apart is shown in the accompanying illustration. This machine is a recent development of the Superior Machine & Engineering Co., 1930 Ferry Park, Detroit, Mich. One of the principal features of the machine is that the work is clamped and unclamped automatically by the movement of the table. The table can be regulated to dwell long enough for the operator to have ample time for reloading. Also, the table feed can be disengaged at any time so that the table and fixture can be operated by hand for convenience in setting up jobs. Graduated dials are provided for the adjusting screws.

Various designs of fixtures could be applied to this machine for handling different kinds of work. The spindle speeds are changed by means of pulleys, and the table feed by means of change-gears. The machine is intended for rapid production and can be quickly changed from one job to another. It is also made in a single-spindle style.

The machine can be driven direct from a main lineshaft or by a motor. The driving pulley is designed for a 4-inch belt, and is 10 inches in diameter. The machine weighs approximately 2000 pounds.



Automatic Milling Machine Made in Single- and Double-spindle Styles by the Superior Machine & Engineering Co.

Rego Welding and Cutting Torch

A cutting torch weighing only 46 ounces with the tip attached has been added to the line of Rego welding and cutting equipment manufactured by the Bastian-Blessing Co., 240-258 E. Ontario St., Chicago, Ill. This torch has an overall length of 20 1/4 inches from the base of the handle to the end of the tip nut. Easy handling, economical operation, and wide adaptability as to fuel gases and range are advantages claimed for the new torch. By merely changing the tip, the torch is made ready for use with acetylene, hydrogen, carbo-hydrogen, oxy-acetylene, and liquefied petroleum gases.

* * *

X-Rays in Industry

The application of X-rays in the industry is constantly increasing. An interesting example of the industrial use of X-rays is found in the inspection of castings for auto-gyro planes. The casting for the main support of the tripod arrangement, carrying the revolving autogyro, is subjected to severe strain. X-ray investigations of these castings made by the Westinghouse X-Ray Co. have shown that external appearances are very misleading. By the use of X-rays, it has been found possible to select the castings that are perfect.

X-rays are being used for industrial inspection purposes all over the world. The German State Railways employ X-ray machines in their shops as an everyday tool of inspection to discover concealed imperfections. X-ray investigations have also been developed to a very high degree in Russia, where the most advanced methods known to science and industry are being employed in this work.

Personals

E. O. WILLIAMS, formerly manager of the Howe Chain Co., has been placed in charge of the Philadelphia office of the Union Chain & Mfg. Co., Bourse Bldg., Philadelphia, Pa.

M. J. KEARINS, formerly associated with Whitman & Barnes, Inc., Detroit, Mich., has joined the combined Latrobe Tool Co. and J. M. Carpenter Tap & Die Co. in the capacity of president and general manager, with headquarters at Latrobe, Pa.

F. F. ELLIOTT has been appointed mill and foundry general superintendent of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. H. F. SEIFERT has been made superintendent of the brass foundry and copper mill. C. R. STEVENS has been appointed purchasing engineer.

CHARLES E. SKINNER, assistant director of engineering of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., was elected president of the American Institute of Electrical Engineers at the annual meeting of the Institute held at Asheville, N. C., in June.

ELLSWORTH L. MILLS, formerly sales manager for the Bastian-Blessing Co., Chicago, Ill., maker of Rego and Red Star welding equipment, has been elected

Ellsworth L. Mills

vice-president of the company. Mr. Mills will continue to have charge of sales.

RALPH M. HOFFMAN, for eight years manager of the Seattle office of the Pacific Division of Link-Belt Co., 910 S. Michigan Ave., Chicago, Ill., has been appointed vice-president and sales manager of that division, with headquarters at 400 Paul Ave., San Francisco, Calif. He succeeds HAROLD H. CLARK who retired June 1 after thirty years' association with the company.

EUGENE C. CLARKE was elected president of the Chambersburg Engineering Co., Chambersburg, Pa., manufacturer of forging and pressing equipment, at a recent meeting of the board of directors. Mr. Clarke succeeds WILLIAM HERBERT DERBYSHIRE, JR., who has been made chairman of the board. ARTHUR G. DICKSON was elected vice-president. The other officers remain unchanged.

J. M. HIPPLE has been appointed general works manager of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

J. M. Hipple

C. H. CHAMPLAIN, manager of the Westinghouse Works at Sharon for the last eight years, succeeds Mr. Hipple as works manager at East Pittsburgh. M. L. FAWCETT has been appointed works manager at Sharon. A. B. REYNDERS, in addition to his present duties as works manager at East Springfield, Mass., will have supervision over the operations of the Mansfield Works, and J. E. BARKLE will have supervision over the Newark Works, in addition to his duties as works manager at South Philadelphia.

ERNEST WEST STINER, formerly western field counsellor for Bigelow, Kent, Willard & Co., has joined the executive staff of the A. C. Nielsen Co., Chicago, Ill., merchandising engineers, in the capacity of vice-president and western manager. For the last thirteen years Mr. Stiner has devoted the major part of his time to solving problems of general management and distribution.

M. L. ECKMAN, development engineer with the Federal Machine & Welder Co., Warren, Ohio, sailed on July 18 for Europe to supervise the installation of welding machinery in France, England, Germany, and Italy. Mr. Eckman expects to assist in training the welding personnel of several large manufacturing concerns. He also intends to spend some time lecturing on welding procedure.

L. S. WASHINGTON has been appointed manager of the northeastern section of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., and E. D. STEWART has been made manager of the southwestern section. Mr. Washington will have complete charge of all activities in the St. Louis and Memphis offices, and Mr. Stewart will have charge of all activities in the Houston, Dallas, San Antonio, and El Paso offices.

T. J. PACE has been appointed assistant to vice-president of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., in charge of general market planning and research analysis. M. B. LAMBERT has been made sales manager in charge of the transportation department; O. F. STROMAN has been appointed sales manager in charge of the industrial department; and R A. NEAL becomes sales manager in charge of the central station department.

ALEXANDER TAYLOR, assistant to vice-president of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has been assigned to duties concerned with the Pennsylvania Railroad locomotive contract, and H. C. THOMAS, director of manufacturing stocks, will have general supervision over Mr. Taylor's previous activities. E. R. NORRIS has been appointed assistant to the general works manager and C. G. BUNNELL, formerly purchasing agent at East Pittsburgh,

C. H. Champlain

has been made general purchasing agent.

RICHARD L. BINDER, president of the Metals Coating Co. of America, Philadelphia, Pa., sailed for Europe on July 7. He is making a business trip with the object of getting in touch with important developments abroad and gaining first-hand knowledge of the opportunities afforded by Germany in view of the economic adjustment that is now under way. Mr. Binder intends to visit the company's plants at Hamburg and Berlin. He will be accompanied by Dr. Leopold Pessel, chemist and metallurgist of the company.

J. A. DOUCETT has been appointed vice-president and general sales manager of Revere Copper & Brass, Inc., 230 Park Ave., New York City. Mr. Doucett was previously vice-president and assistant general sales manager. Before that he was president of the Michigan Copper & Brass Co., in Detroit, now the Michigan division of Revere Copper & Brass, Inc. Announcement is also made of the appointment of Vincent W. Allen as manufacturing manager of the corporation. Mr. Allen will be located at the general offices at Rome, N. Y. He was previously works manager of the Michigan division at Detroit.

News of the Industry

FUSION WELDING CORPORATION, 103rd St. and Torrence Ave., Chicago, Ill., has appointed the Puritan Compressed Gas Corporation of Kansas City, Mo., distributor for the Weldite line of welding rods.

UNION CHAIN & MFG. CO., Sandusky, Ohio, has appointed the Industrial Gear & Machine Works, 225 Sixth Ave., Oakland, Calif., exclusive distributor for the Union line of chains and power transmission equipment.

REED-PRENTICE CORPORATION and the RIVETT LATHE & GRINDER CORPORATION, announce that the Detroit office has been moved to 6-246 General Motors Bldg. These companies manufacture lathes, milling machines, internal grinders, and special machinery.

MILLHOLLAND SALES & ENGINEERING CO., manufacturer of automatic drilling, tapping, and milling units, and special production machinery, has removed the general offices and factory of the company from 1800 Ludlow St. to 1145 E. 22nd St., Indianapolis, Ind.

THE FARREL-BIRMINGHAM CO., Ansonia, Conn., has recently enlarged its welding department and installed new equipment to provide adequate facilities for building all-steel welded power presses and other special machinery to which the welding process is applicable.

ALFRED HERBERT, LTD., Coventry, England, has appointed J. C. Blair, director of the dealers' side of their business. Mr. Blair is planning to visit the United States to make personal contact with the American machine tool manufacturers who are represented by the Alfred Herbert organization in England and other foreign countries.

JOSEPH T. RYERSON & SON, INC., Jersey City, N. J., announces that the agency contract between the company and Paul H. Petersen, Inc., 420 Lexington Ave., New York City, has been terminated. All export machinery inquiries and orders are now handled directly by the export department of Joseph T. Ryerson & Son, Inc., at the Jersey City office.

NORTHERN ENGINEERING WORKS, 210 Chene St., Detroit, Mich., has appointed R. E. Condit, with offices at 901 E. 3rd St., Dayton, Ohio, and 705 Gwynne Bldg., Cincinnati, Ohio, to take charge of the sale and distribution of Northern traveling cranes and electric hoists in the Dayton, Cincinnati, and Columbus districts of the state of Ohio. The company also announces the appointment of the Hill Equipment Engineering Co., 4620 Delmar Blvd., St. Louis, Mo., as representative in that district.

Obituaries

TRUMAN P. GAYLORD, vice-president of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., died suddenly on July 5 in Shelby, Mich., his boyhood home, where he had been visiting his mother. Mr. Gaylord was born in the town where he died. He attended the Allen Academy of Chicago, the University of Michigan, from which he was graduated with the degree of electrical engineer, and the Armour Institute of Technology, from which he secured a degree in 1895. From 1893 to 1898 he was assistant professor of electrical engineering at Armour Institute, and in 1899 he entered the employ of the Westinghouse organization. He was appointed district manager of the Chicago office in 1902, and held that position until he was made acting vice-president in August, 1914. He was elected vice-president in April, 1929. Mr. Gaylord was a member of the American Institute of Electrical Engineers, the Chamber of Commerce of the United States, the Duquesne Club of Pittsburgh, and the Pittsburgh Athletic Club.

HARRY J. PARKE, for many years purchasing agent for the Gisholt Machine Co., Madison, Wis., died July 6.

Coming Events

AUGUST 10-25—Meeting of the Industrial Institute at Silver Bay, Lake George, N. Y. The meeting embraces four industrial divisions as follows: Industrial supervision; plant training; personnel principles and methods; and conference of smaller industries. For further information, address Charles R. Towson, secretary, the Industrial Institute, 347 Madison Ave., New York City.

AUGUST 23-29—International Industrial Relations Congress to be held at Amsterdam, Holland. Further information may be obtained from Mary van Kleeck, Russell Sage Foundation Bldg., New York City.

SEPTEMBER 6-12—First International Congress of the International Association for the Testing of Materials in Zurich, Switzerland. Further details can be obtained from C. L. Warwick, secretary-treasurer, American Society for Testing Materials, 1315 Spruce St., Philadelphia, Pa., or from W. H. Fulweiler, chemical engineer, United Gas Improvement Co., Philadelphia, Pa.

SEPTEMBER 17—Fall meeting of the Steel Founders' Society of America, Inc., in Chicago, Ill. Managing director, G. P. Rogers, 932 Graybar Bldg., New York City.

SEPTEMBER 21-25—Annual meeting of the American Society for Steel Treating and National Metal Exposition to be held at the Commonwealth Pier, Boston, Mass. W. H. Eisenman, secretary, 7016 Euclid Ave., Cleveland, Ohio.

SEPTEMBER 28-30—Convention of the American Association of Engineers at Huntington, W. Va. Secretary, M. E. McIver, 8 South Michigan Ave., Chicago, Ill.

OCTOBER 7-8—Production Meeting of the Society of Automotive Engineers at the Book-Cadillac Hotel, Detroit, Mich. R. S. Burnett, Director, Production Activity, 29 W. 39th St., New York City.

OCTOBER 12-16—Thirteenth annual convention and exhibition of the American Gas Association at Atlantic City, N. J. For further information, address J. B. Nealey, American Gas Association, 420 Lexington Ave., New York.

OCTOBER 13-16—Twenty-fifth annual convention of the Illuminating Engineering Society at the William Penn Hotel, Pittsburgh, Pa. For further information, apply to the secretary, Illuminating Engineering Society, 29 W. 39th St., New York City.

OCTOBER 15-16—Fourth annual convention of the Gray Iron Institute at the West Baden Springs Hotel, West Baden Springs, Ind.

OCTOBER 27-29 (date changed from NOVEMBER 10-12)—National Transportation Meeting of the Society of Automotive Engineers at the Shoreham Hotel, Washington, D. C. Robert S. Burnett, Director, Transportation and Maintenance Activity, 29 W. 39th St., New York City.

NOVEMBER 30-DECEMBER 4—Annual meeting of the American Society of Mechanical Engineers at the Engineering Societies' Building, 29 W. 39th St., New York City. Calvin W. Rice, secretary, 29 W. 39th St., New York.

NOVEMBER 30-DECEMBER 5—First National Exposition of Mechanical Handling Equipment to be held at the Grand Central Palace, New York City. Charles F. Roth, Manager, International Exposition Co., Grand Central Palace, New York City.

New Books and Publications

SAFETY IN STRUCTURAL AND SHEET-METAL FABRICATION. 16 pages, 8½ by 11 inches. Published by the National Safety Council, Inc., 20 N. Wacker Drive, Chicago, Ill.

MECHANISM. By Robert McArdle Keown. 242 pages, 6 by 9 inches. Published by the McGraw-Hill Book Co., Inc., 370 Seventh Ave., New York City. Price, $2.50.

This is a revised edition of a book published some years ago, the original text having been revised by Virgil Moring Faires, professor of mechanical engineering of the Agricultural and Mechanical College of Texas. An attempt has been made in the new edition to modernize the book and yet, at the same time, maintain the general plan, which has appealed to a great many teachers. At the end of each chapter problems are given applying to the material presented in that chapter. The chapters have been rearranged so as to place the least difficult ones first. For the convenience of both the student and the instructor, the number and variety of problems have been greatly increased. The chapters on gearing have been largely rewritten.

New Catalogues and Circulars

INSULATING FIREBRICK. Babcock & Wilcox Co., 85 Liberty St., New York City. Bulletin descriptive of a new firebrick with insulating properties for furnaces.

SOCKET WRENCHES. Blackhawk Mfg. Co., Milwaukee, Wis. Folder on Blackhawk production socket wrenches and drivers, giving complete data including important dimensions.

RADIAL DRILLING MACHINES. Western Machine Tool Works, Holland, Mich. Circular 70, illustrating and describing Western "Low-Hung Drive" radial drilling machines equipped with "Twin Disc" clutches.

BEARINGS. Wagner Electric Corporation, 6400 Plymouth Ave., St. Louis, Mo. Bulletin S-349, discussing the problem of bearing seizure and the advantages of steel-backed babbitt-lined bearings in electric motors.

BRAKES Wagner Electric Corporation, 6400 Plymouth, Ave., St. Louis, Mo. Bulletin SD-338, outlining the Wagner brake service, which is available for operators of trucks, trailers, buses, pleasure cars, taxicabs, etc.

HACKSAWS. Armstrong-Blum Mfg. Co., 343 N. Francisco Ave., Chicago, Ill. Catalogue illustrating and describing Marvel high-speed hacksawing machines, which are built with or without automatic bar feed.

BALL BEARINGS. New Departure Mfg. Co., Bristol, Conn Circulars for loose-leaf folder, Nos. 196-FE and 197-FE, showing ball bearings applied to deep-well pump motors and industrial clutches, respectively.

MILLING CUTTERS. Ingersoll Milling Machine Co., Rockford, Ill. Circular illustrating applications of Ingersoll inserted-tooth milling cutters, showing how the different types are adapted for various classes of milling.

ELECTRIC CONTROL EQUIPMENT. Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa. Bulletin 841, treating of the automatic reversal of open-hearth furnaces. The system is described in detail.

PIPING AND VALVES. Semet-Solvay Engineering Corporation, 40 Rector St., New York City. Bulletin 44, descriptive of Semet-Solvay piping and valves. Tables of dimensions and diagrams of operating arrangements for gate valves are included.

SHEET-METAL WORKING MACHINES. Niagara Machine & Tool Works, 637-697 Northland Ave., Buffalo, N. Y. Bulletin 78, containing data on machines and tools for sheet-metal working, including snips, shears, stakes, hammers, mallets, and roofing tools.

GEAR-TOOTH CHAMFERING MACHINES. City Machine & Tool Works, E. 3rd at June, Dayton, Ohio. Circulars illustrating and describing the new No. 3 Peerless gear-tooth chamfering machine which is made in two types—plain and universal.

SLING CHAINS. American Chain Co., Inc., Bridgeport, Conn. Catalogue giving complete information on all the standard types of sling chains made by this company. In addition to specifications, instructions governing the purchase and use of chain are given.

ELECTRIC MOTORS. Ideal Electric & Mfg. Co., Mansfield, Ohio. Bulletin 520, illustrating and describing this company's line of synchronous motors and their application. Dimension charts covering the flywheel type motors and six other standard types are included.

ELECTRIC CONTROLLING APPARATUS. Allen-Bradley Co., 1331 S. First St., Milwaukee, Wis. A series of bulletins and price sheets covering recent developments and improvements in a number of Allen-Bradley control units, including contactors and starting and reversing switches.

INDICATING AND RECORDING EQUIPMENT Brown Instrument Co., 4485 Wayne Ave., Philadelphia, Pa. Circular featuring a new line of potentiometer pyrometers. Six outstanding features of the new instrument are illustrated, and the single-record recorder is also shown.

SPEED REDUCERS. D. O. James Mfg. Co., 1114 W. Monroe St., Chicago, Ill. Catalogue of continuous-tooth herringbone speed reducers and gears. The book contains complete specifications, including horsepower ratings, dimensions, and prices. Many installations of various types of reducers are shown.

BLOWERS AND COMPRESSORS. Ingersoll-Rand Co., 11 Broadway, New York City. Bulletin 3132, illustrating and describing the Ingersoll-Rand line of turbo-blowers and turbo-compressors. The booklet covers the construction and operation of single-stage and multi-stage blowers and turbo-compressors.

OPTICAL INSTRUMENTS. Gaertner Scientific Corporation, 1201 Wrightwood Ave., Chicago, Ill. Bulletin 126, entitled "Optical Instruments of Recent Design," illustrating and describing comparators, rapid-setting wavelength spectrometers, ultra violet monochromators, and polarizing spectrophotometers.

TAPS. Geometric Tool Co., New Haven, Conn. Catalogue covering the Geometric line of Class S collapsing taps, which are applicable to practically all machines and may be used for internal threading of any parts over 1¼ inches in diameter. In addition to the standard line of tools, a few special tools are shown.

LATHES. Western Machine Tool Works, Holland, Mich. Catalogue 100, covering the complete line of Chard Timken-bearing equipped lathes, which are manufactured in three types—namely, high-speed manufacturing, multi-speed geared-head, and heavy-duty cone-head engine lathes, and in sizes from 16 to 28 inches.

PUMPS. Brown & Sharpe Mfg. Co., Providence, R. I. Circular illustrating various types of B & S pumps which are suitable for a broad range of applications, including the supplying of coolant on machine tools, the maintaining of pressure for hydraulically operated machines, forced-feed lubrication, and general circulation of liquids.

INDUSTRIAL FURNACES. Chicago Flexible Shaft Co., Chicago, Ill. Catalogue 105, containing data on the Stewart line of industrial furnaces, which ranges in size from small bench-type heat-treating furnaces to large car-type annealing furnaces. Typical examples of these furnaces are shown, including a few of the electric type furnaces.

BALL AND ROLLER BEARINGS. Norma-Hoffmann Bearings Corporation, Stamford, Conn. Catalogue containing engineering data sheets, giving sizes, dimensions, and load ratings of Norma-Hoffmann precision ball, roller, and thrust bearings. The catalogue also gives instructions for mounting these bearings, and information on lubrication and protection.

SHAPERS. Columbia Machine Tool Co., Hamilton, Ohio. Bulletin 18, illustrating and describing the Columbia line of heavy-duty shapers. The details of construction are described, and are made clear by an illustration in which the various important features are shown by red arrows. Complete specifications for the various sizes are included.

SPEED REDUCERS. W. A. Jones Foundry & Machine Co., 4401 W. Roosevelt Road, Chicago, Ill. Catalogue on Jones worm-gear speed reducers, illustrating the various types and showing a number of applications. The booklet also gives information on selecting the correct worm-gear speed reducer for the job, and gives list prices of the different types.

FURNACES AND AUXILIARY EQUIPMENT. Babcock & Wilcox Co., 85 Liberty St., New York City. Bulletin descriptive of the B. & W. No. 80 laboratory furnace, intended for melting small samples of ceramic materials or non-ferrous metals, heating metals for treatment, or other laboratory purposes. Bulletin treating of B. & W. No. 80 refractory cements and plastics.

AUTOMATIC DRILL HEADS AND DRILLING MACHINES. Millholland Sales & Engineering Co., P. O. Box 1622, Indianapolis, Ind., has compiled a series of cam and gear charts and data sheets for Millholland automatic drill units that simplify the calculations for changing the cams and gears on these machines. This information will be mailed to those interested upon request.

SPECIAL PROCESS EQUIPMENT. Babcock & Wilcox Co., 85 Liberty St., New York City. Bulletin entitled "Special Process Equipment," describing the fabrication of riveted and welded pressure vessels, tubular equipment, penstock piping, bends, and forgings. One section of the booklet is devoted to a brief discussion of a new welding technique, and another section discusses the production of alloy castings, including heat-resisting alloys and stainless alloys.

SPEED REDUCERS. Horsburgh & Scott Co, 5114 Hamilton Ave., N. E., Cleveland, Ohio. General catalogue of speed reducers, containing 128 pages covering the engineering principles involved in the design and selection of speed reducers, as well as the details of construction of eight types of Horsburgh & Scott worm-gear speed reducers and three types of herringbone speed reducers. The "heli-spur" speed reducer is also described. A feature of the book is a selection chart, which shows at a glance the number of types of reducers that can be used for any given ratio.

SMALL TOOLS. Barber-Colman Co., Rockford, Ill. New edition of catalogue H, entitled "Hobs, Milling Cutters, and Reamers." This book is really a combined handbook and catalogue. It is divided into three principal sections, dealing with standard and special hobs, hobbing machines, and information connected with gear-cutting; standard and special milling cutters of all kinds; and standard and special reamers and reamer sharpening machines. The new features of the catalogue include an explanation of spline shaft hobs and their uses, with particular reference to the newly developed elongated tooth hob, and complete new tables of spline shaft dimensions.

Societies, Schools and Colleges

MICHIGAN COLLEGE OF MINING AND TECHNOLOGY, Houghton, Mich. Bulletin containing announcement of courses for 1931-1932, and general information.

COLUMBIA UNIVERSITY, Morningside Heights, New York City. Catalogue containing outline of courses for the university extension classes in business given in the afternoon and evening.

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Five Parts Every Second—300 a Minute!

Do you know of any die-made part produced at such a rate? September MACHINERY will contain a fully illustrated description of the die and the multi-slide machine used for this exceptional example of press work. Every number of MACHINERY contains at least a dozen good reasons why you should read it each month or at least give each number a careful "once-over" just to keep track of the most important mechanical developments.

AUG 3 1931

AUGUST 1931—THIRTY-SEVENTH YEAR

MACHINERY

THE INDUSTRIAL PRESS Publishers. 140-148 LAFAYETTE ST., NEW YORK

Timken Spindle Bearings Can Be Safely Preloaded

Preloading is simply another name for chatter-proof spindle bearings. When the bearings are preloaded, it means that they are set up with proper load between the contact surfaces when the spindle unit is assembled.

The Timken Bearing is *exclusive* in its ability to withstand preloading without disturbing the geometry of the bearing, because of Timken tapered construction, Timken line contact, Timken positively aligned rolls, Timken precision of manufacture and Timken-made steel.

Consequently, when Timkens are properly preloaded there is no loss of anti-friction efficiency, no danger of premature failure, no loss of spindle rigidity and no undue wear. Just another of the many advantages exclusive to Timken Bearings on machine tool spindles. The Timken Roller Bearing Company, Canton, Ohio.

TIMKEN *Tapered Roller* BEARINGS

First . . . .

AND THERE IS NO SECOND

When rapid production of threaded parts is required, with threads of more than usual accuracy in pitch diameter, in lead, in smoothness—

GREENFIELD'S

MAJOR LINES
Screw Plates
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Unit-Cycle
10 Operations
1000 per hour

DRILLED COUNTERSUNK AND TAPPED

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ACTUAL SIZE

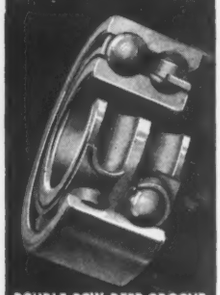
Hydraulic feed to drilling units. Automatic hydraulic indexing of work-table. Automatic clamping and ejecting. Lead screw tapping.

LELAND-GIFFORD CO.
WORCESTER, MASSACHUSETTS

BOSTON CHICAGO CLEVELAND DETROIT NEW YORK PITTSBURGH ROCHESTER

SELF ALIGNING BALL BEARING

DEEP GROOVE BALL BEARING



DOUBLE ROW DEEP GROOVE BALL BEARING

CYLINDRICAL ROLLER BEARING

SPHERICAL ROLLER BEARING

ALIGNING THRUST BEARING

AMBOLD MACHINE TOOL CORPORATION

● *If they're not Precision Bearings*
It's not a Precision Machine

Where PERFORMANCE TAKES PREFERENCE over PRICE

24 SKF's ON GIANT DRILL FOR PRECISION PERFORMANCE

ONE of the largest in Canada, the new "Rheinland" Radial Drill at the plant of the Hamilton Gear and Machine Works, is equipped throughout with 24 SKF Ball and Roller Bearings. The high efficiency of the machine is directly credited to the ease of operation made possible with SKF Bearings.

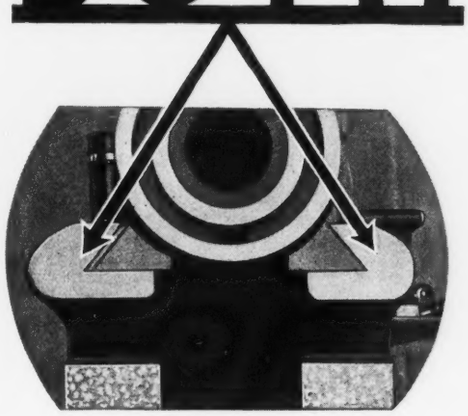
The drill is 13′ 9″ high, has an 8′ swing of the arm and is run by a 10 H. P. motor. It is completely controlled and operated by electricity through automatic push buttons. SKF Bearings on the motors and in the saddle, column and cooling pump bring the high precision, dependability and ease of movement so necessary in a giant machine built for close tolerance work.

SKF INDUSTRIES, INC., 40 East 34th Street, New York, N. Y.

2734

SKF

RAMWAYS SHOULD BE SOLID ON BOTH SIDES

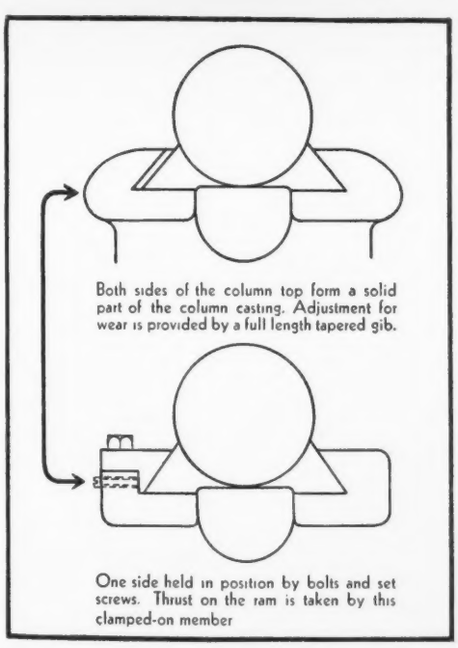


A Shaper with solid ramways on both sides will take cuts more accurately because the thrust on the ram is against a solid backing. All dependence on set screws and bolts to retain clamps and gibs is eliminated.

Solid ramways are adjustable for wear by means of a tapered gib running the full length of the column. It is single screw adjusting and its use forces the ram bearing to wear straight.

If you demand solid ramways on your next Shaper, your purchase will be limited to a Cincinnati Rapid Traverse Shaper.

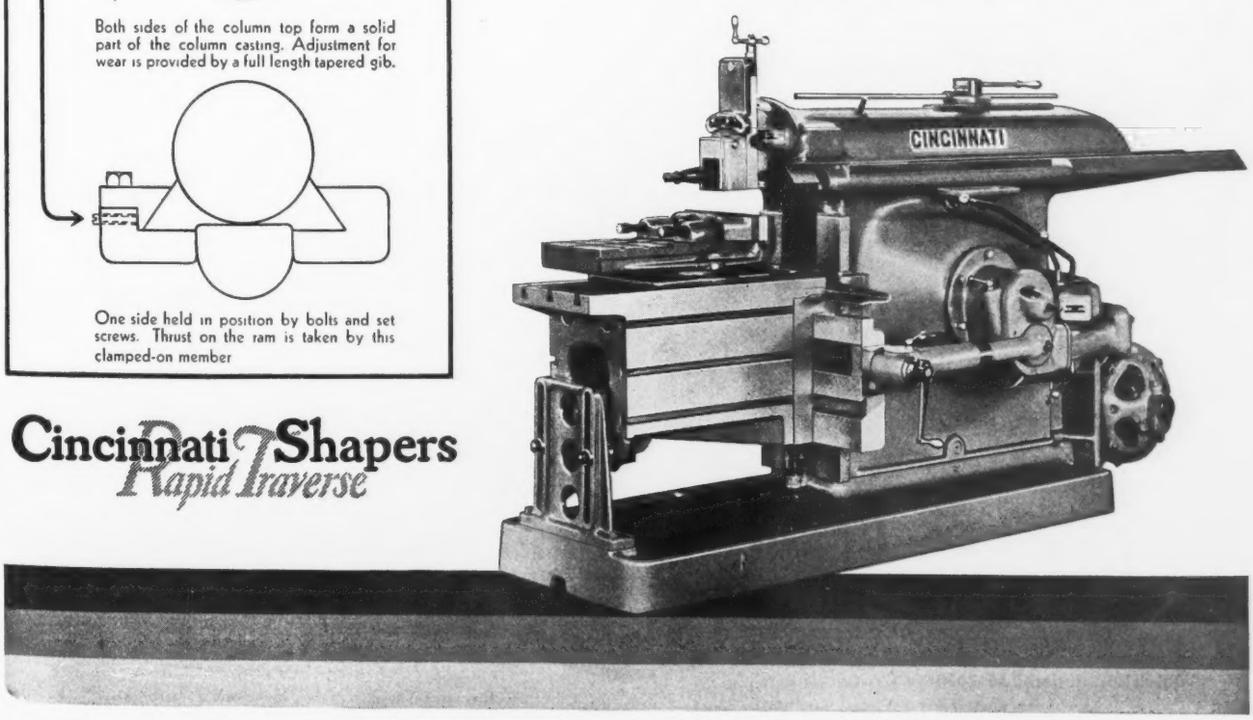
THE CINCINNATI SHAPER CO.
CINCINNATI, OHIO



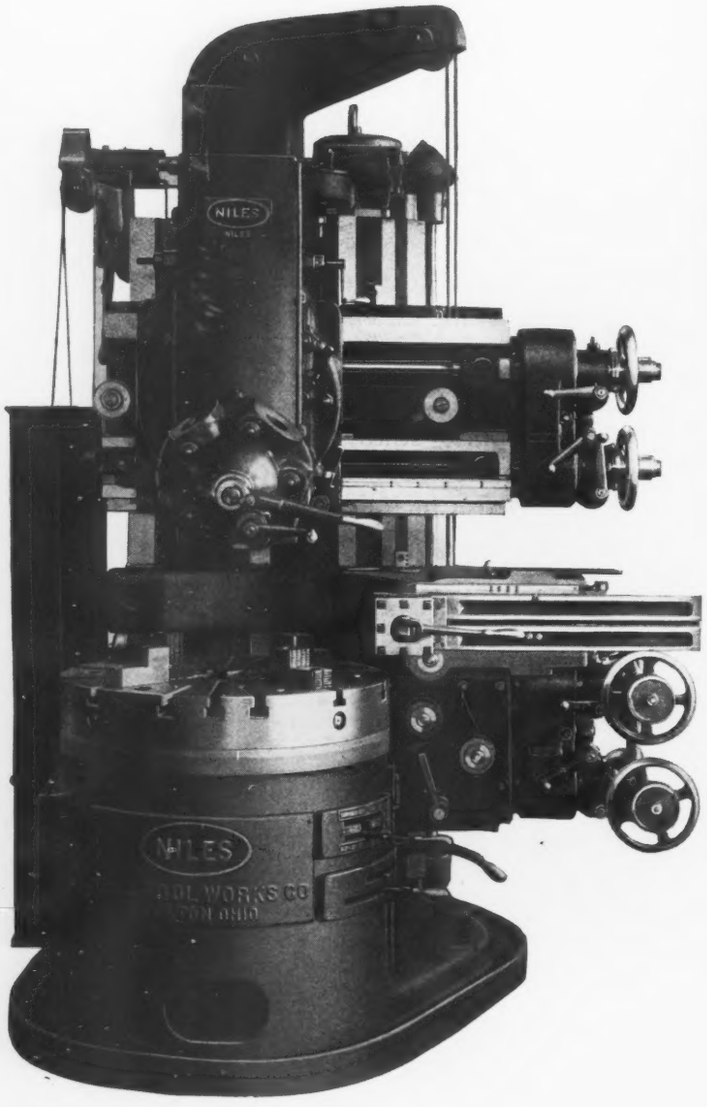
Both sides of the column top form a solid part of the column casting. Adjustment for wear is provided by a full length tapered gib.

One side held in position by bolts and set screws. Thrust on the ram is taken by this clamped-on member

Cincinnati Rapid Traverse Shapers



THERE'S STRENGTH *in this one piece construction*



Column and base are an integral casting.

NILES
Time Saver
SIDE HEAD MILL

has the *Base and Column* cast integral of box construction liberally ribbed to withstand all working strains.

The *Three Track Bearing* for the vertical head saddle makes it impossible for the saddle to cramp under heavy feeds.

The Niles Tool Works Company, Hamilton, Ohio

NILES

Division General Machinery Corporation
(Incorporated Delaware)

Offices in Principal Cities
Foreign Dept.: Niles Bement Pond Co., N.Y.C.

PRATT & WHITNEY

Hartford, Connecticut

announce a new electric gage, known as the Electrolimit Gage, which will be marketed through the regular sales offices of the Pratt & Whitney Company. The electrical parts are of General Electric manufacture. The gage manufacturing facilities and experience of the Pratt & Whitney Company and the electrical developments of the General Electric Company have made it possible to bring the outstanding advantages of this new superior gaging method within the scope of general shop use.

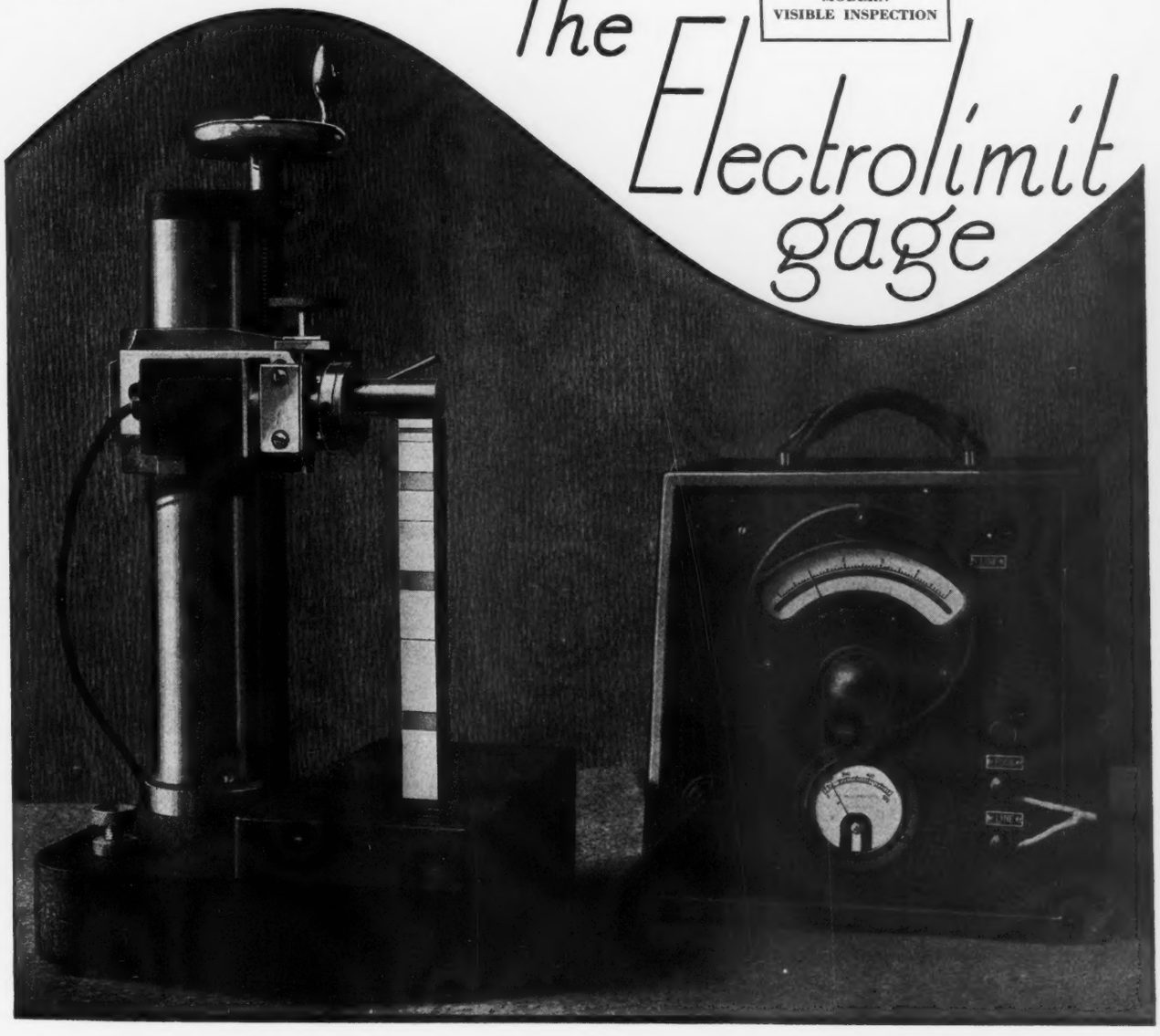
The Electrolimit Gage heretofore has been confined largely to the standards laboratory, but its superior inspection methods and speed now can be used economically to replace many mechanical gaging operations. Standardized brackets and fittings will be available, which will adapt the new gage to a wide field of production applications.

Complete information can be obtained in the near future from Pratt & Whitney Branch Offices located in Birmingham, Boston, Chicago, Cincinnati, Cleveland, Detroit, Los Angeles, New York, Philadelphia, Pittsburgh, Rochester, St. Louis and San Francisco.

The illustration below shows the Electrolimit Gage being set for external work using Hoke Blocks. The gage can be arranged for internal work by a simple change.

MODERN VISIBLE INSPECTION

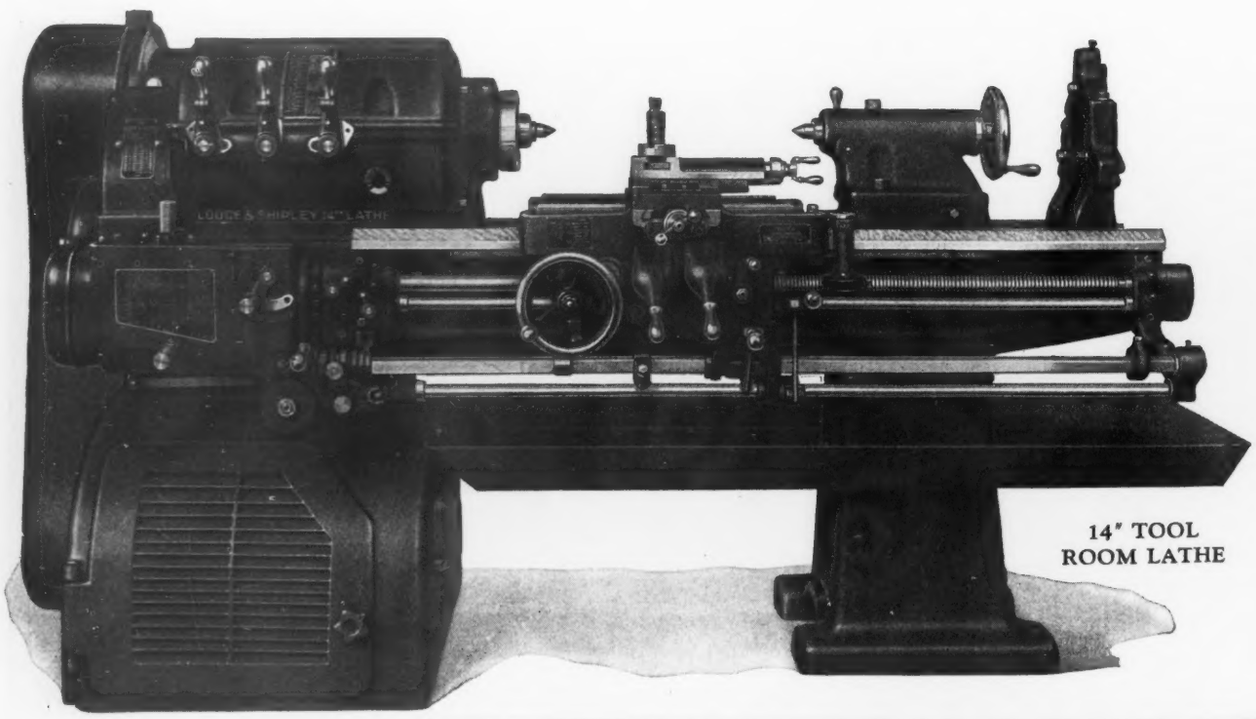
The Electrolimit gage



at your

L & S LATHES

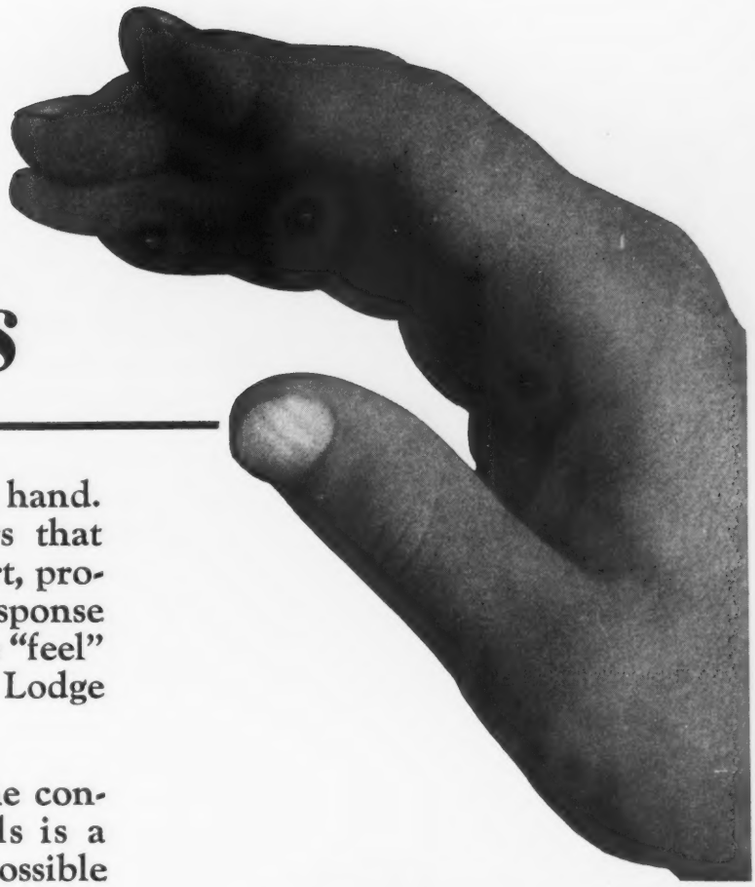
▲▲▲▲ LATHES!
GOOD LATHES
ONLY ▲▲▲▲▲



14" TOOL
ROOM LATHE

THE LODGE & SHIPLEY MACHINE

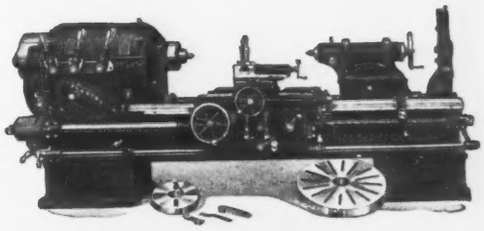
r *Fingertips*



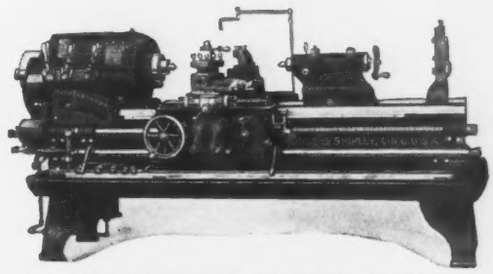
All controls right under your hand. At your fingertips are levers that handle without physical effort, producing a smooth, positive response . . . levers that have a definite "feel" that identifies the lathe as a Lodge & Shipley.

This ease of manipulating the conveniently grouped controls is a characteristic that makes possible more profitable production. Thru the elimination of all unnecessary motions, there is *less time* required for setting-up and *more time* given to actual cutting.

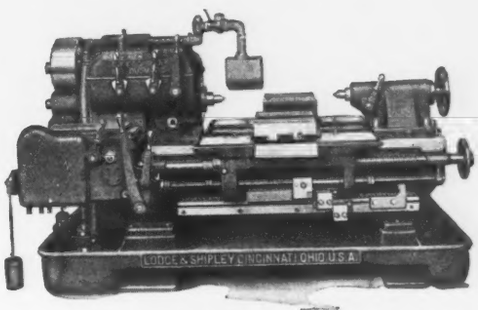
Before deciding on your next lathe equipment, let us show you the new Lodge & Shipley Lathe. There is one in your locality.



ENGINE LATHES 12″ TO 48″



MANUFACTURING LATHES 12″ TO 36″



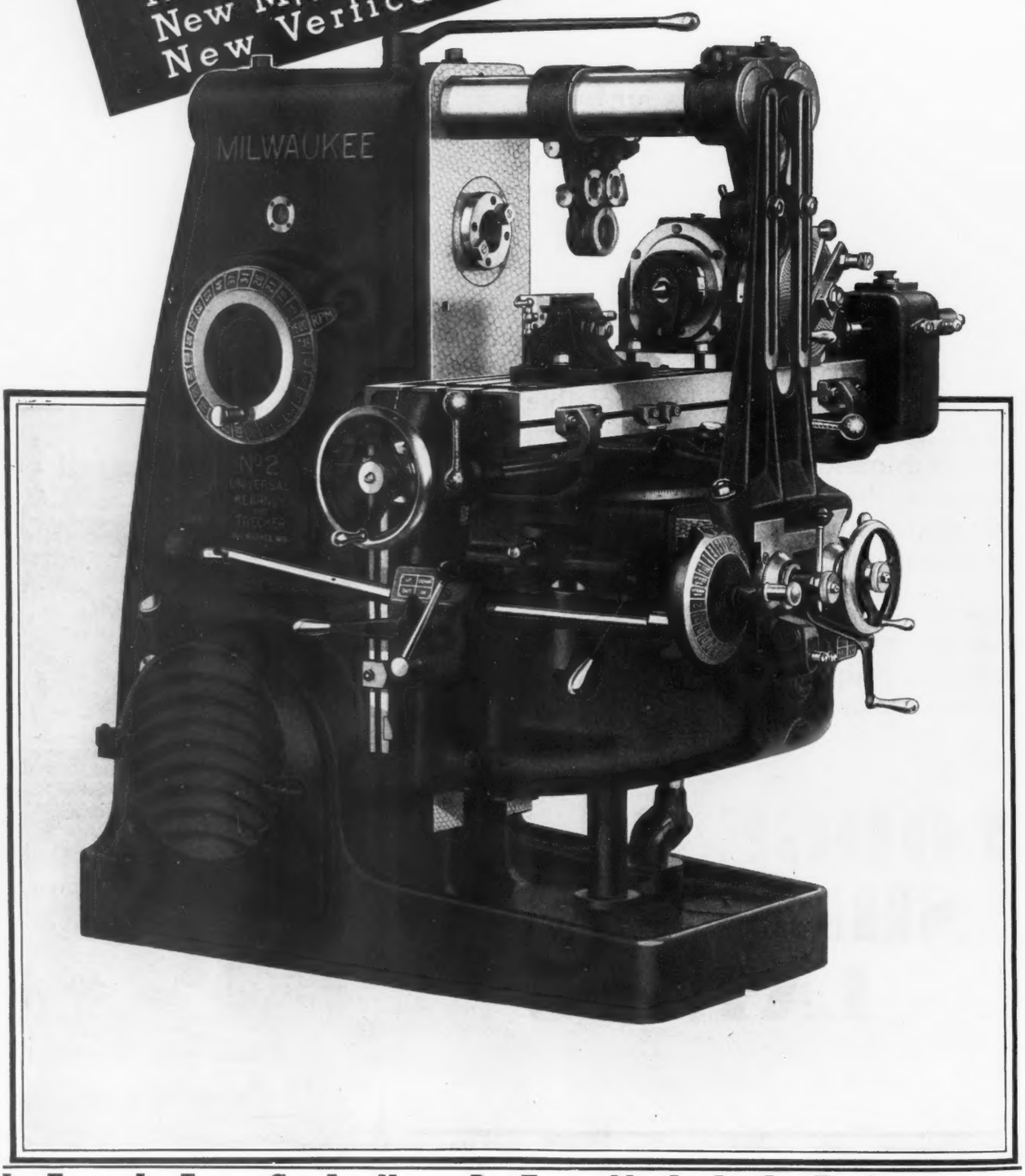
DUOMATIC LATHES

LODGE & SHIPLEY LATHES

NE **TOOL CO., Cincinnati, Ohio, U. S. A.**

IMPORTANT NEW

5 NEW MODELS
New Universals
New Plain Types
New Mfg. Types
New Verticals



I F I T C A N B E M I L L E D « «

FACTS about the Knee-Type MILWAUKEES

These new Milwaukee Knee-Type Milling Machines are so unusual and spectacular that there is no need for bombastic descriptions or exaggerated claims. We will let the new Milwaukees speak for themselves.

100 to 1 Speed Range

The customary speed ratio of 25 to 1 has been boosted to 100 to 1. For the first time, a milling machine gear train has been provided to give the *proper* surface speed for *all sizes* of cutters. The new Milwaukee has 27 changes of speed from 15 r.p.m. to 1500 r.p.m., arranged in geometrical progression of 1.2 ratio. The "steps" between speeds are actually less than on milling machines having but a quarter of the range. The new Milwaukee has more speeds, broader range, and finer selection.

Worm Driven Spindle

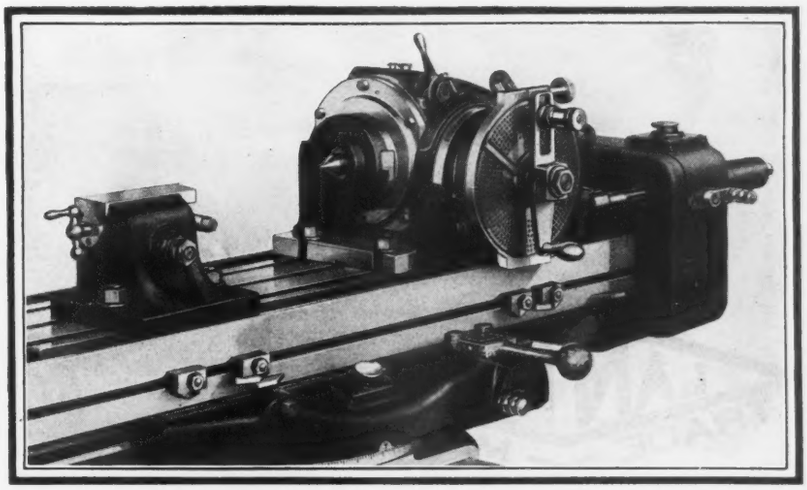
Proper surface speeds for every size of cutter and every type of milling operation are provided through the one spindle . . . smooth and silent drive for the high speeds; rugged drive for the intermediate speeds; and massive powerful drive for the heavy-torque slow rotation speeds. Although the spindle revolves up to 1500 r.p.m., *no other shaft or gear in the spindle gear train runs faster than 600 r.p.m.*

Center Bearing Spindle

The introduction of a center bearing on the spindle is a marked advance in milling machine design. This new construction makes the spindle 10 times stiffer without adding any undue load on the bearings.

240 to 1 Feed Range

Like the speeds, the feed range has never before been adequate on a milling machine . . . too fast for delicate work and too slow for modern TC cutters. In the new Milwaukee we have overcome both the high and low limitations by providing a feed range from ¼-in. to 60-in. per minute with 27 changes in the geometrical progression of 1.23 ratio.



Hypoid Spiral Bevel Gear Dividing Head . . . a new invention

This amazing new Dividing Head will divide *all* consecutive members up to 500 . . . and many beyond. It will actually cut, *by power,* 40,362 *different* leads from as fine as 38 threads to the inch all the way up to 2900 inches in one turn.

The customary worm and wormwheel have been replaced by a Hypoid Spiral Bevel Gear and Pinion. The preloaded ball bearing precision spindle has accuracy *permanently* built in . . . vibration and overhang eliminated! Unsteady hand feed and "Hard" drives for short leads are abolished by introducing an auxiliary table drive shaft, driving direct to the Dividing Head and Change Gears, and then to the table screw. This same auxiliary shaft also provides for rotary milling without table advance. Uniform advance cams of any lead whatever as well as face and barrel cams may now be milled on the new Milwaukee Knee Type Universal.

Also, an entirely new thread milling attachment with this new Dividing Head makes it possible, for the first time, to cut tapered threads as well as straight threads on a Standard Universal tool room milling machine.

The 6-way power rapid traverse rate is 150 in. per min. for the table and 75 in. per min. for knee and saddle.

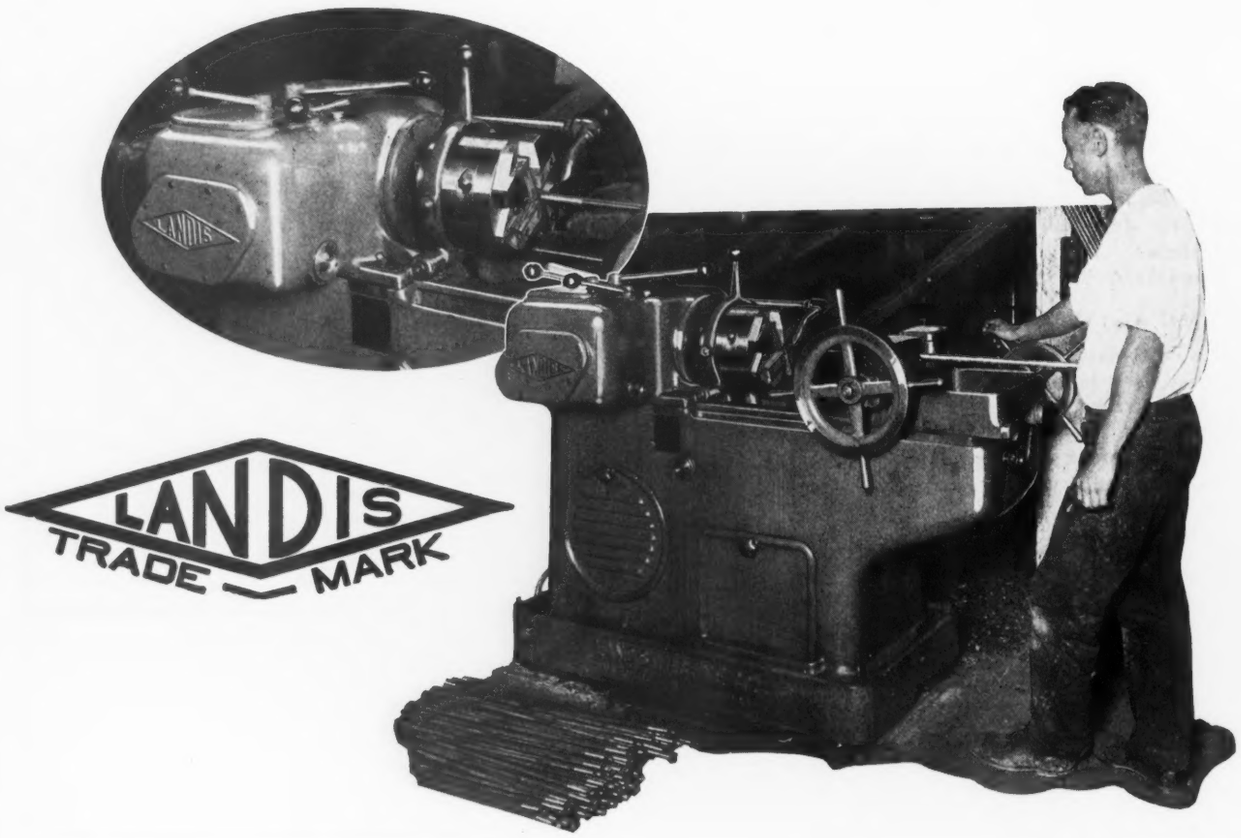
Many More Features

Scores of other features are embodied in these new Milwaukees: Single lever dials, readable at 30 to 40 feet; unique dual control; improved table height; completely accessible motor; direct V-belt drive; hinged center arbor support; enlarged double overarms; extremely rigid column; Sponson knee; center ribbed saddle; automatic lubrication system . . . and a new Sliding Head Vertical with step-million feature . . . COME to MILWAUKEE and see these remarkable machines.

KEARNEY & TRECKER
MILWAUKEE
MILLING MACHINES

« « M I L L I T F A S T E R !

The New Landmaco



THE LANDIS LINE

LANDMACO Threading Machines
LANDEX Heads for Automatic Screw Machines
LANDMATIC Heads for Turret Lathes and Screw Machines
LANCO Heads for Automatic, Semi-Automatic and Hand-Operated Threading Machines
Threading Machines
Bolt Factory Threaders
Automatic Forming and Threading Machines
Pipe Threading and Cutting Machines
Pipe and Nipple Threading Machines
Roller Pipe Cutters
Stationary Pipe Die Heads
Victor Collapsible and Adjustable Taps.

LANDMACO Threading Machines at the Belmont Iron Works, Philadelphia, Pa., have Improved Threads and Doubled Production on Soft Steel Bolts and Rods

LANDIS MACHINE COMPANY, INC., Waynesboro, Pa.
DETROIT: 5928 Second Blvd. CLEVELAND: 504-505 Marshall Bldg.
Agents in all Principal Cities of the World

Wins Instant Acceptance

Well known manufacturers have put the seal of their approval on the New Landmaco Threading Machines. They are already making production records in large and important plants—adding their quota to the fine reputation built by the long line of Landis Threading Equipment.

It is the new design of course that makes Landmaco Threading Machines leaders. All our experience—our specialized knowledge of threading production needs—has gone into these machines to provide greater efficiency, extra wearing qualities and extra capacity for producing accurate screw threads.

Here are a few of the high points:

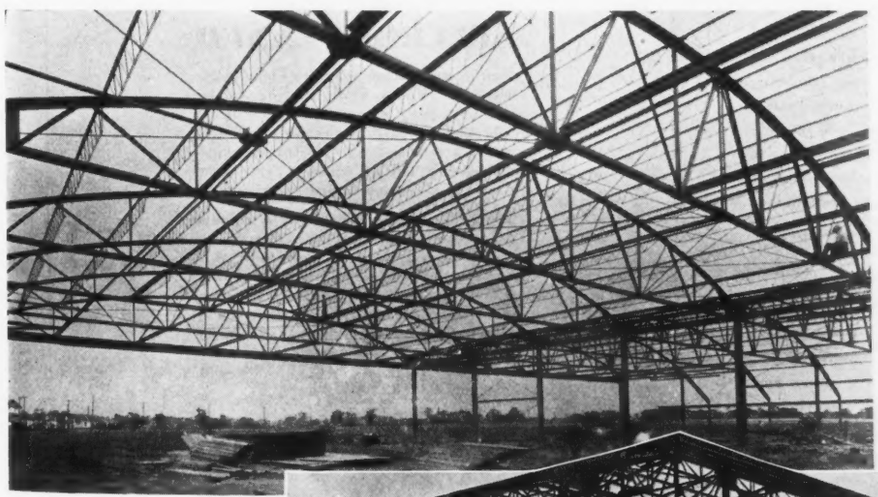
Selective type **gear box** providing eight spindle speeds, with hardened and burnished chrome nickel steel gears, heat treated alloy steel shafts, anti-friction bearings, flood lubrication and friction clutch control.

Spindle mounted on pre-loaded ball bearings and driven by spiral bevel gears.

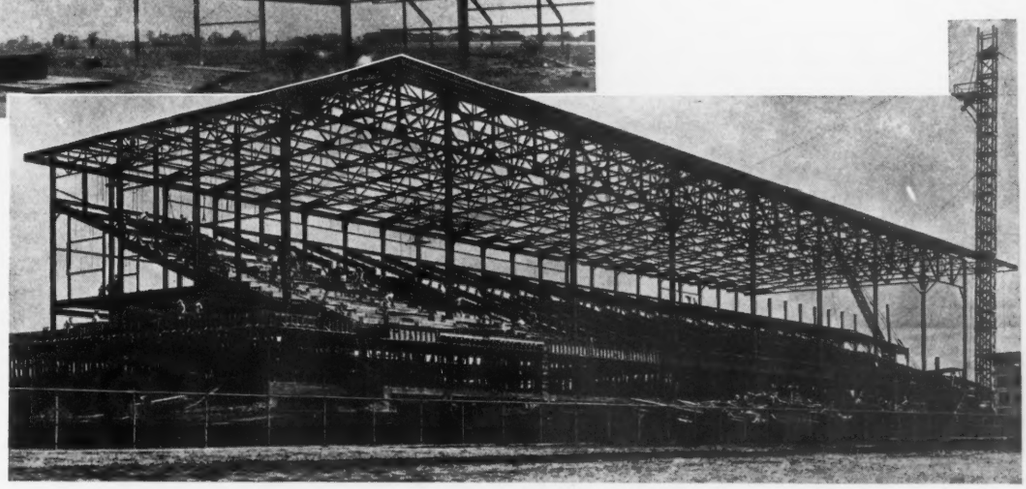
Low pressure gear type pump with direct drive and automatic reverse. Built in assembly removable for inspection without disconnecting piping; **motor-in-base** with silent chain drive.

The *New* Landmaco Threading Machines are made in 1″ and 1½″ single and double head models, all equipped with Lanco Heads.

For super-accuracy, these machines can be equipped with lead screws and Landis Ground Thread Chasers.

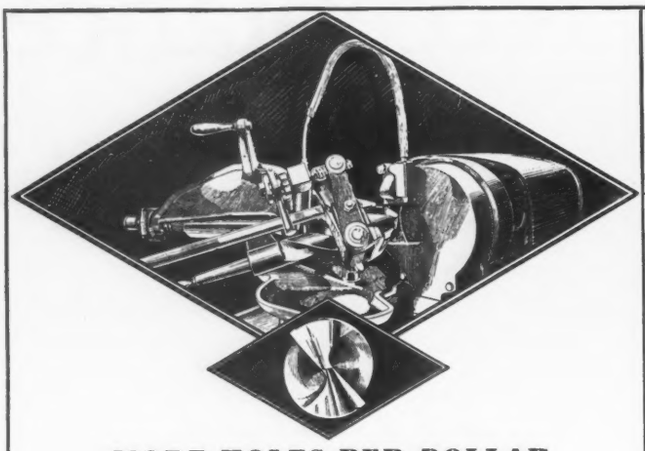


The **lead screw,** which takes the thrust load by direct contact with the carriage, is located centrally between the guides, mounted on pre-loaded ball bearings and fully enclosed in a steel tube. A lead screw nut of the split full-nut type with an adjustable segment eliminates backlash.



Send for catalogs of this new Landis machine and revised catalogs of the entire line.

DON'T TOLERATE INEFFICIENCY



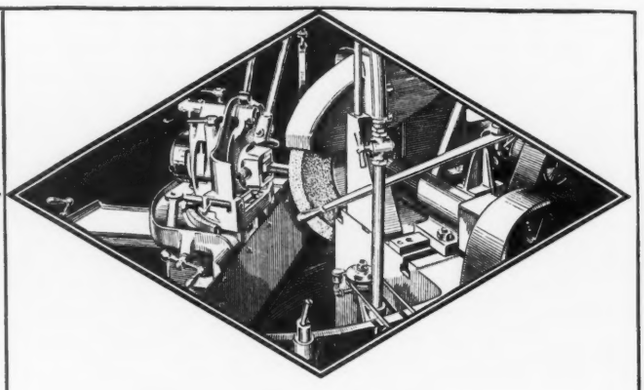
MORE HOLES PER DOLLAR

How can your most efficient drilling machines produce maximum results if the drill points do not cut into the metal with efficiency?

To relieve the machine of strain and to produce the greatest number of holes in the shortest time, each lip of a drill must have the same inclination to the axis, lips must be of equal length, and have the proper clearance at both center and periphery.

Then each lip will do its proper share of the cutting, produce a perfectly cylindrical hole of accurate size—thereby saving reaming, cutting assembly time, speeding production and reducing costs.

The Sellers Drill Point is the point recommended by leading drill manufacturers. It is the point that is reproduced automatically on one or a million drills with the same positive precision, by the Sellers Drill Grinder. Fast. So easy to operate any tool room attendant can use it. Write for further details.



SHARPENING THE TEETH OF INDUSTRY

A machine can be no more efficient than the cutting tools it employs. Hence, the Sellers Tool Grinder which rapidly, accurately and automatically produces and reproduces the correct angles by formula on every cutting tool, will guarantee the maximum quality and quantity of work from each machine in your shop. It will centralize grinding at one point, keeping men at their machines engaged in productive work. It will lengthen the life of both tungsten carbide and high speed steel tools by eliminating wasteful grinding. It will speed production and reduce shop costs.

SELLERS MACHINE TOOLS +

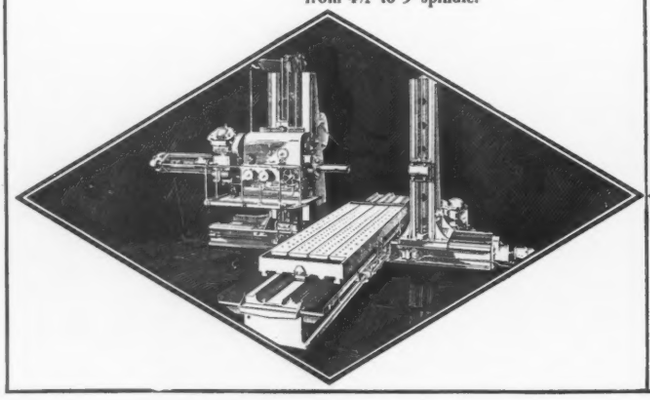
FLEXIBILITY

a Sellers + Quality

The Sellers Floor Borer saves time, cuts production costs, economizes floor space, reduces machine tool investment. It bores, drills and mills, and the machine illustrated is provided with a planer-bed and table, further enhancing its flexibility.

This modern tool, the result of over sixty years of development and design experience, has been built not only to serve the increased production demands of today, but to anticipate those of the future.

Built in floor plate, planer table and revolving table types in sizes from 4½' to 9' spindle.

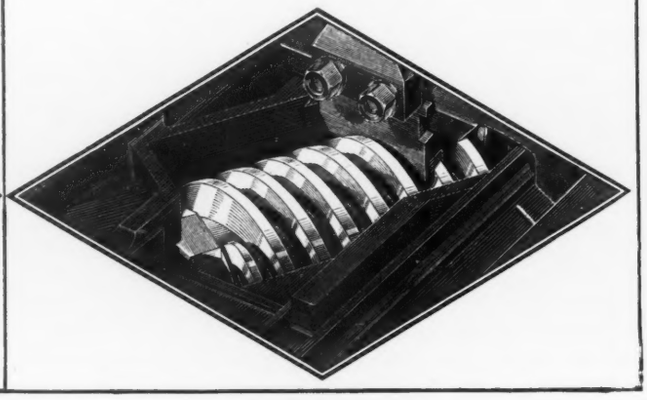


THE HEART OF THE SELLERS PLANER

Rest your hand on a Sellers Planer table while at work. Feel it glide softly, smoothly, easily, without the slightest sign of vibration or chatter. See the amount of metal it removes in its stride—the superior surface left for finishing—the short time the finishing operation requires.

The Sellers Spiral Gear Drive is responsible. Simplicity itself, this drive comprises but three gears between motor and table rack—two herringbone and the Sellers Spiral Gear. The Spiral Gear has never less than six teeth in contact with the rack. It imparts a steady, continuous, powerful pressure resulting in the smoothness of operation which distinguishes all Sellers Planers.

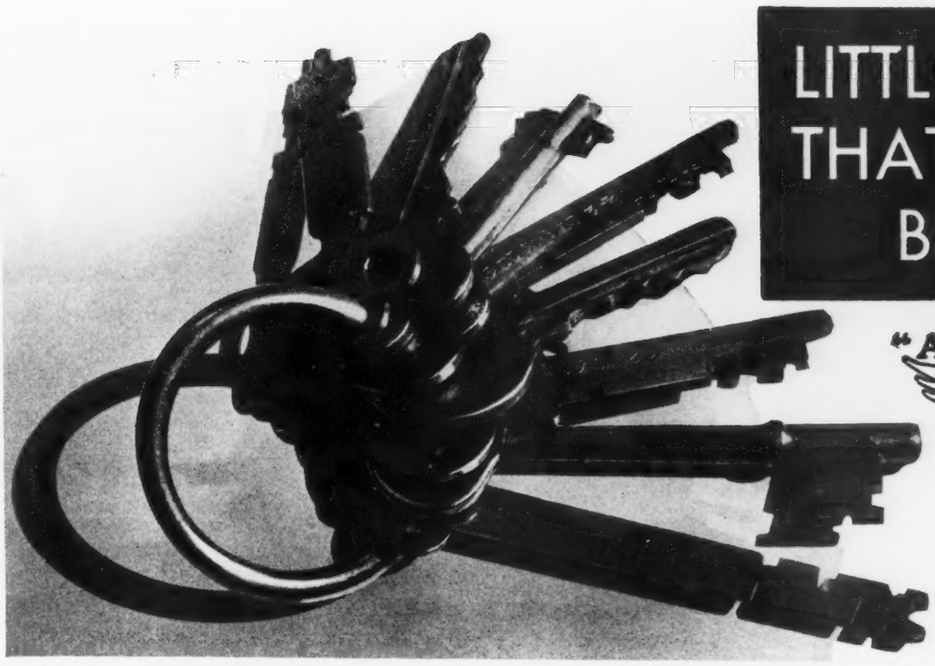
Sellers Planers are built in sizes from 36" to 196"



WILLIAM SELLERS & COMPANY

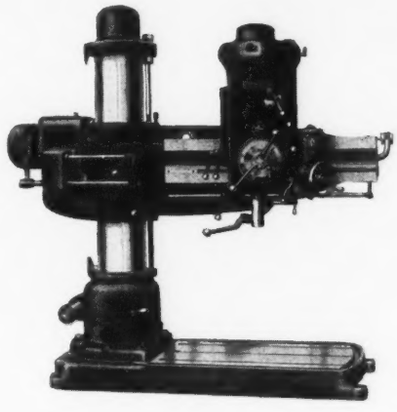
INCORPORATED

ESTABLISHED 1848 PHILADELPHIA, U.S.A.



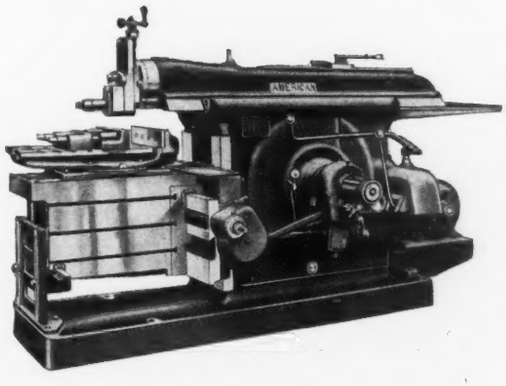
LITTLE THINGS THAT COUNT BIG ...

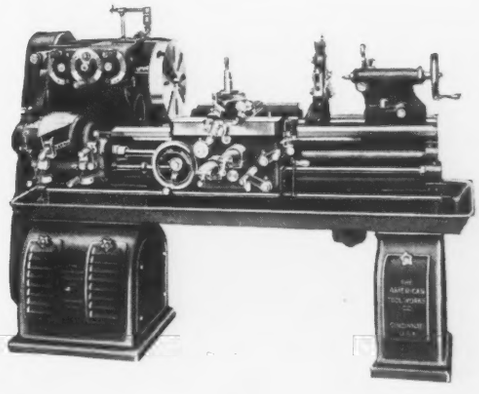
"AMERICAN"



In size and value, the lock and key are out of all proportion to the property they often protect. They really are among the little things that count big, like the details in the manufacture of "American" Lathes, Radials and Shapers. Through years of experience in building fine machines, we naturally realize that the useful, accurate life of our products depends on attention to detail. The small, but fine elements of our machines, such as the fit of a bearing, the surface of a way, the seasoning of a casting, the play in controls, are all given closest attention. If these, and a host of other details are carefully watched, the larger parts, the machines as units, will function at their best over the greatest period of time.

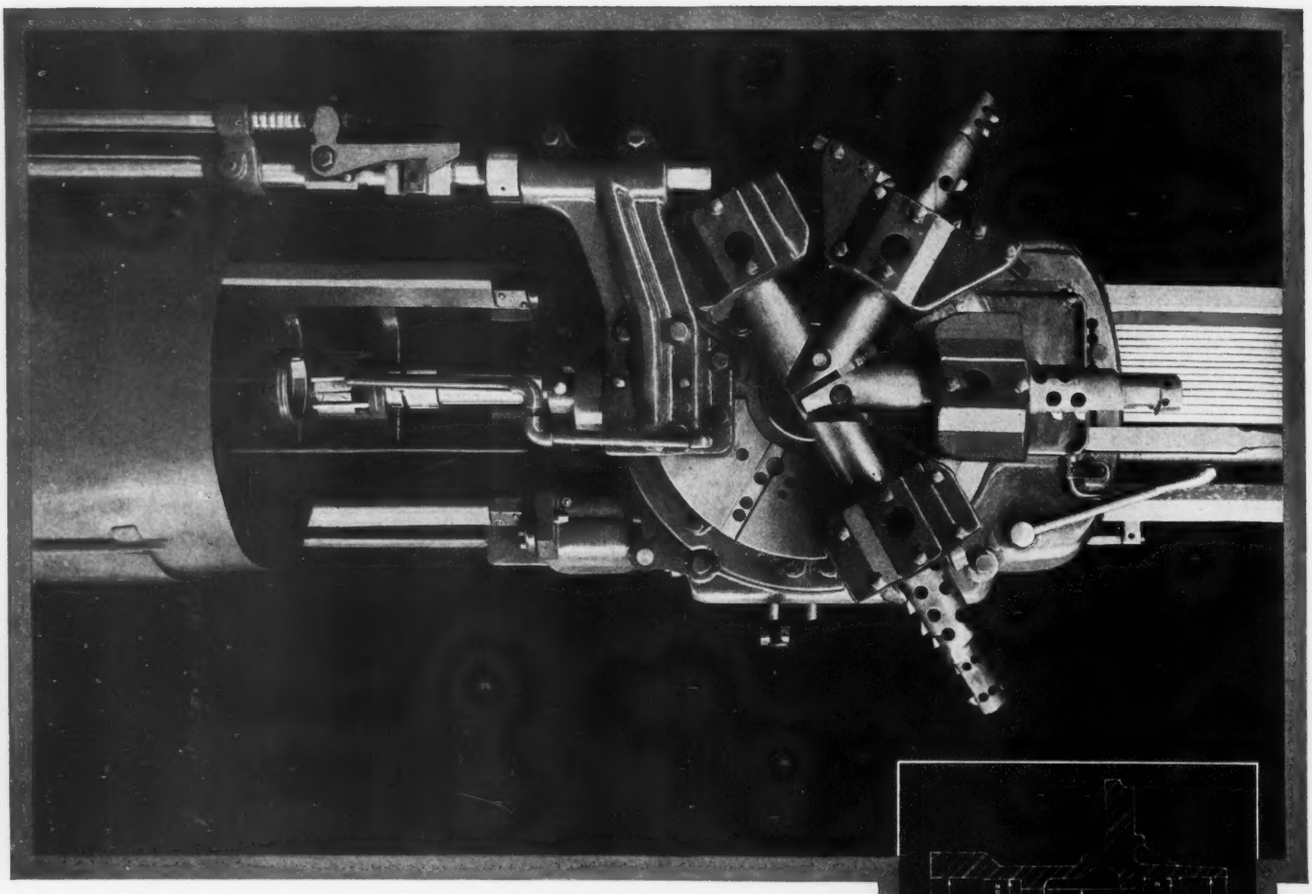
THE AMERICAN TOOL WORKS CO.
CINCINNATI, U. S. A.

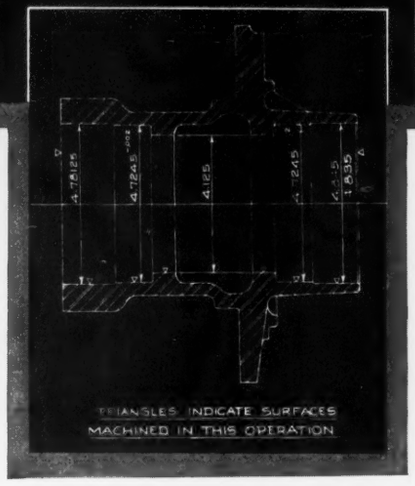




"AMERICAN"

LATHES • RADIALS • SHAPERS





Boring, facing and reaming both ends of large automobile truck hub in one setting

The J & L feature of cross sliding head plays an important part in performing these operations. Expensive special tooling is unnecessary.

The piece is held in a three-jaw electrically-operated chuck with the large bore toward the turret.

The hub is machined as follows:

FIRST TURRET POSITION

The turret is moved toward the headstock. A special boring bar rough bores all the diameters simply by feeding the cross-sliding head over so as to bring the boring tools into the proper depth for the front and back bores. The turret is then fed toward the headstock to complete the five different diameters in the bore.

SECOND TURRET POSITION

The tooling and machine movements for this position are identical with those for the first position except that all bores are finished to reaming size.

Jones & Lamson Machine

THIRD TURRET POSITION

The combined back and front facing tool bar faces all inner and outer faces on both ends of the hub at the same time by the simple motion of traveling the cross-sliding head. While these faces are being finished, an additional grooving tool makes the oil retainer groove on the outside of the hub.

FOURTH TURRET POSITION

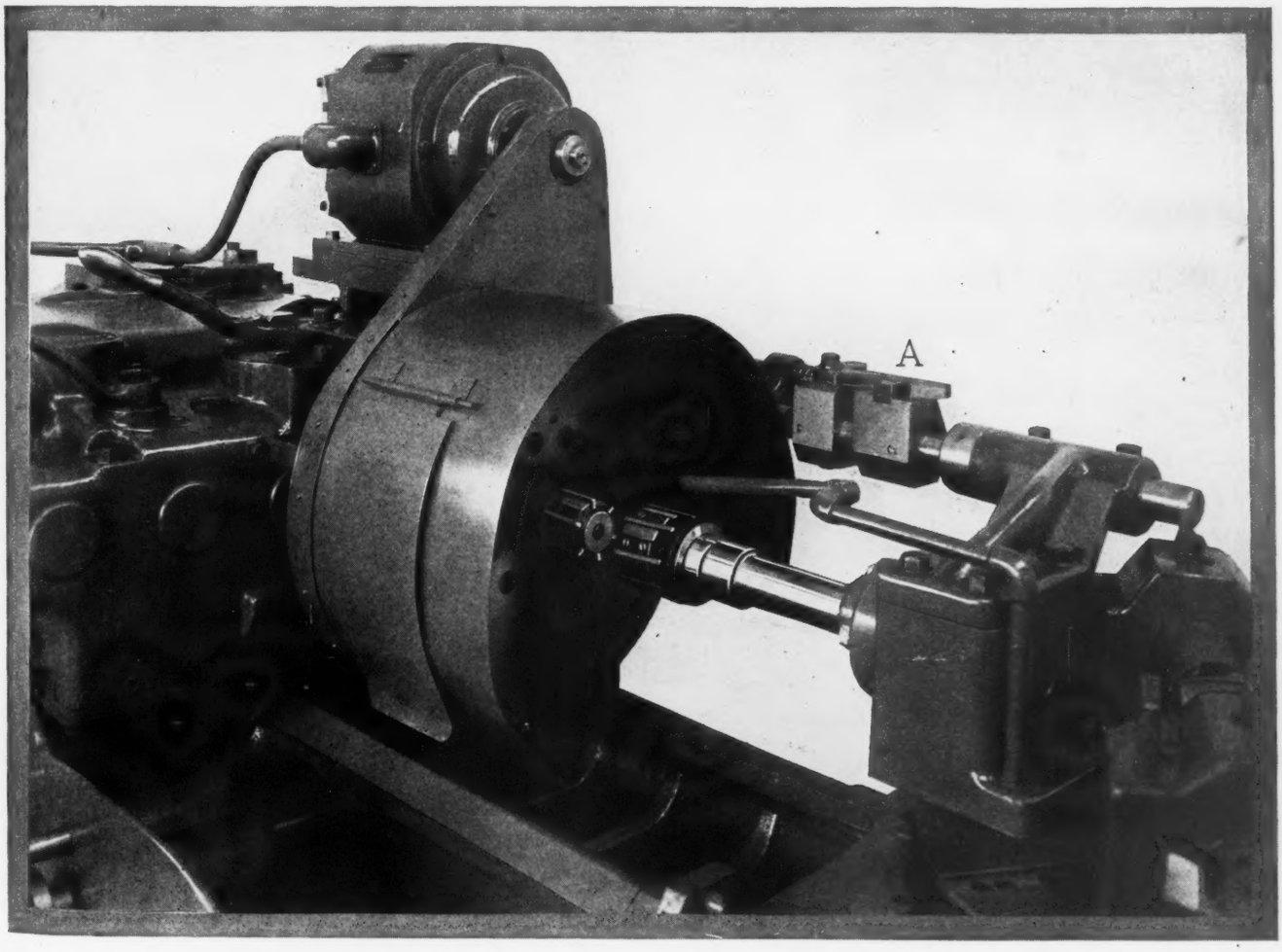
Both ball bearing seats are reamed simultaneously in the following manner: the turret carries a large adjustable reamer for reaming the large or outer ball race seat; the back reaming and facing attachment carries an adjustable reamer which reams the inner ball race seat.

The tooling of the machine for this complete operation is noteworthy in that all the boring bars are free from supporting pilots at their outer ends. Pilots are unnecessary because of the Flat Turret construction and the method of anchoring all bars together over the center of the Turret.

The back reaming device is unique, being fully automatic in its actions which are governed by the position of the Turret and the positive returns of the back reamer.

A continuous production of 27 pieces per hour is obtained.

The interlocking locking latch at "A" assures the positive withdrawal of the back reamer into the chuck body on the completion of the reaming of the ball bearing seat.

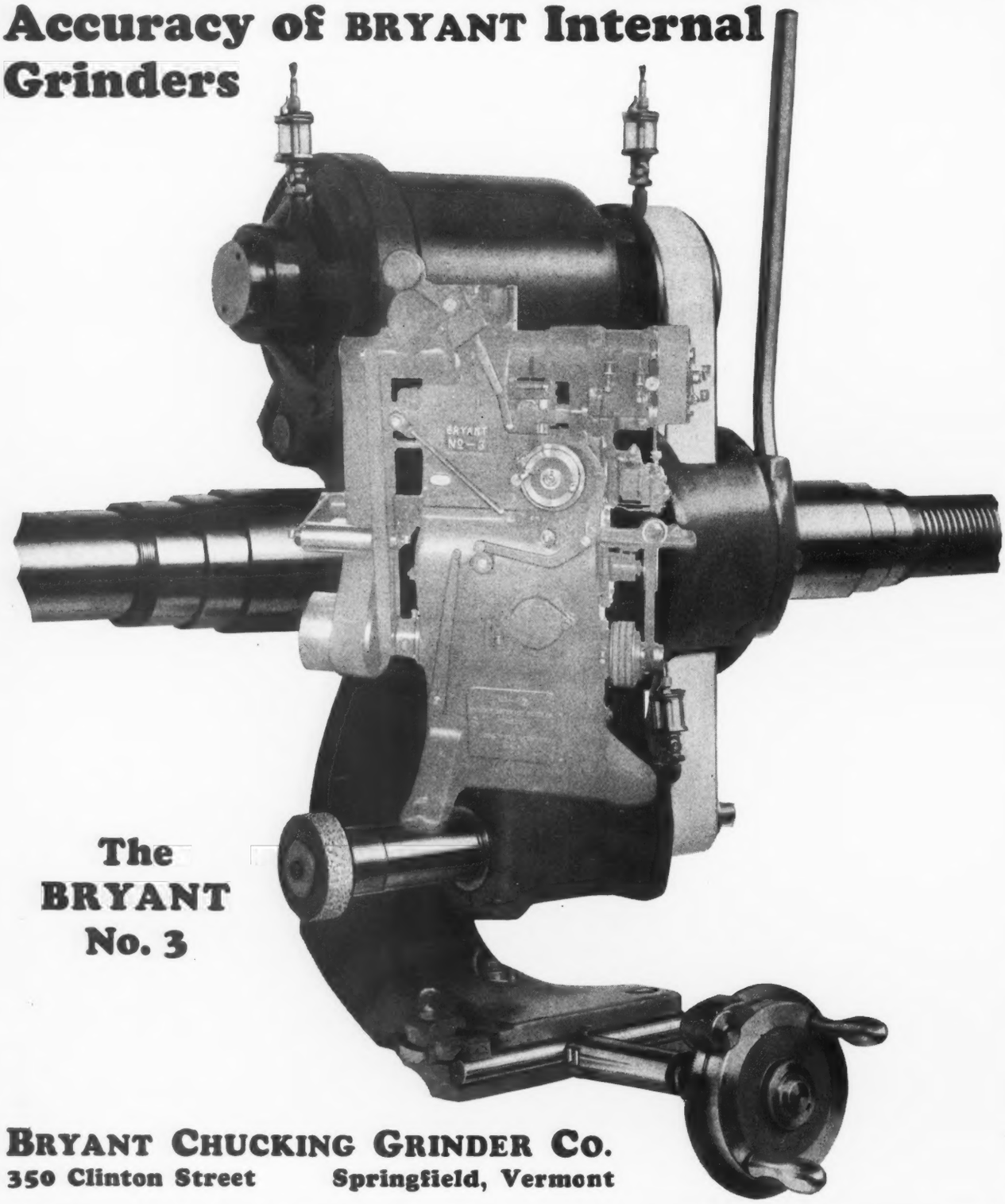


Company, Springfield, Vt.

Control Reduced To Its Elements

Three Points

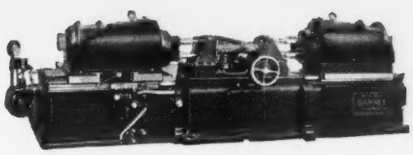
The Secret behind the Strength and Accuracy of BRYANT Internal Grinders



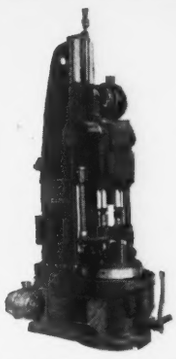
The BRYANT No. 3

BRYANT CHUCKING GRINDER CO.
350 Clinton Street Springfield, Vermont

STANDARD & SPECIAL DRILLING & BORING MACHINES

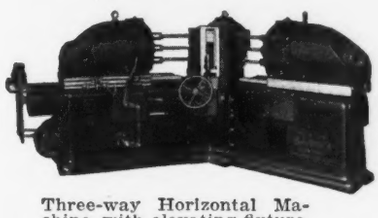


Horizontal Duplex Machine, with Hydraulic feed, for drilling radiator sections.



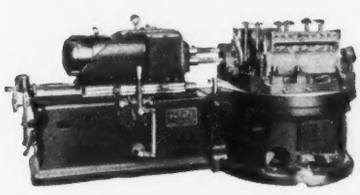
Vertical Hydraulic Feed Boring and Reaming Machine, with rotary table. Machining is progressive and continuous except for indexing.

Another development of our Four-way Horizontal Machine.

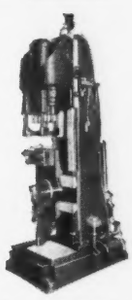


Three-way Horizontal Machine, with elevating fixture, for drilling and reaming differential centers.

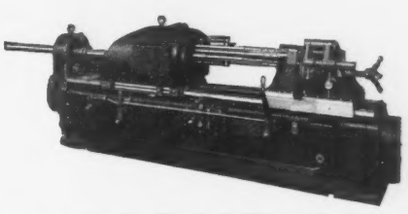
Horizontal Duplex Heavy Duty Drilling and Reaming Machine with station type fixture.



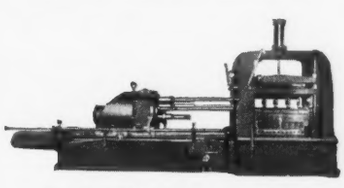
Horizontal Boring Machine with Rotating Table. A standard type for high production on crankcase and transmission case boring.



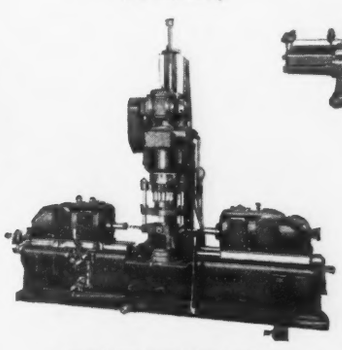
Vertical Drilling and Reaming Machine with special fixture mounted on column.



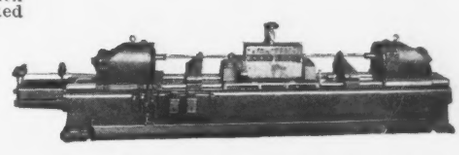
Single Head Drilling, Boring and Tapping Machine with screw feed.



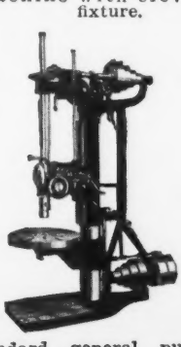
Horizontal Crankcase Boring Machine with elevating fixture.



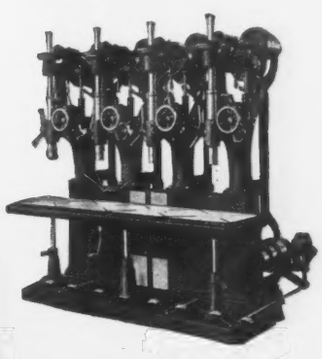
Combination Vertical and Horizontal Machines to meet special requirements.



Horizontal Duplex Machine for long-hole drilling.



Standard general purpose Drilling Machines—Stationary and sliding Head types.



Gang Drills in a variety of sizes. Write for specifications.

A SERVICE WHICH GIVES HIGH PRODUCTION WITH LOW MAINTENANCE

by

W. F. and John Barnes Co.

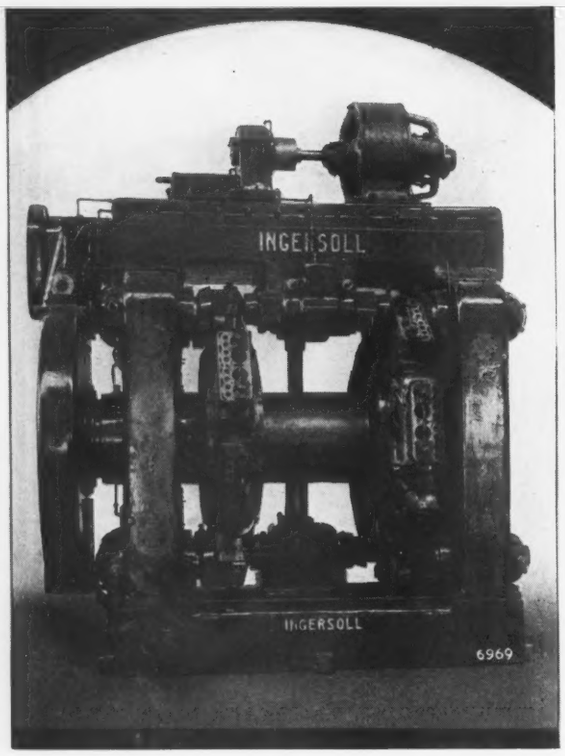
ROCKFORD, ILLINOIS

Established 1872

INGERSOLL MACHINES

FOR

HIGH OR LOW PRODUCTION



Ingersoll machines give satisfactory performance because they are built for the job. The problem is not how the job may be adapted to the machine, but rather what type of machine will best suit the job. This is determined by your job requirements.

The machine at the left is a 12-spindle 4-station drum type milling machine for milling the sides of cylinder blocks. The production is 192 cylinder blocks per hour.

The four horizontal spindle milling machine at the bottom performs a similar operation for another manufacturer. Production is 12 cylinder blocks per hour.

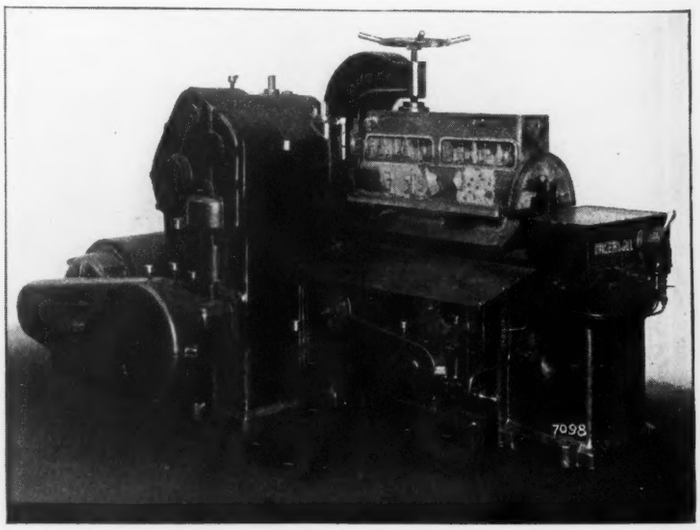
These two machines perform similar operations but the difference in design was determined by the production requirements.

BULLETINS:

No. 46 "Ingersoll Equipment for Railroad Shops"

No. 47 "Ingersoll Milling Machines"

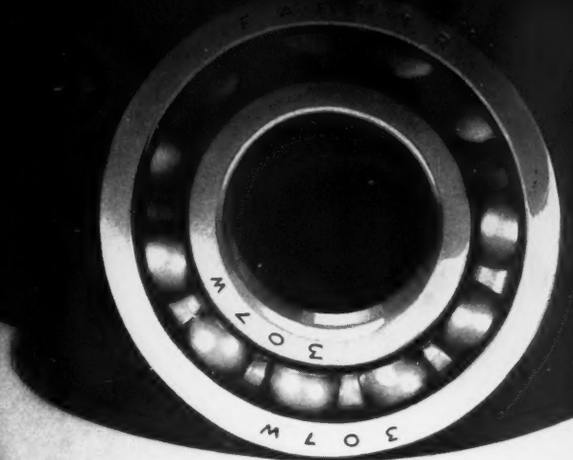
No. 49 "Ingersoll Milling Cutters"



THE INGERSOLL MILLING MACHINE COMPANY

ROCKFORD ILLINOIS, U.S.A.

LOAD SUSTAINING



Protection against heavy loads

IS POSITIVE *with* FAFNIRS

STAMINA to sustain enormous loads in motion year after year, without perceptible wear. Bearings must have this quality in order to withstand the service severities of power shovels, scrapers, tractors and similar construction machinery.

Leading manufacturers have found the answer in deep race Fafnir Ball Bearings which banish friction and wear to an unsurpassed degree. Gears, wheels and shafts retain their original alignment and maintenance is reduced to normal lubrication.

In recognition of the flawless service which Fafnirs are rendering in machinery of every description, manufacturers are making ever increasing use of these friction-free bearings. More Fafnirs—less wear. Hence longer, more accurate life for machines that are Fafnir equipped. This fact makes machines more reliable and much more economical to own.

THE FAFNIR BEARING COMPANY
New Britain, Connecticut

NEW YORK · CINCINNATI · CHICAGO · ATLANTA · DETROIT · DALLAS
CLEVELAND · LOS ANGELES · NEWARK · MILWAUKEE · PHILADELPHIA

FAFNIR BALL BEARINGS

It would be funny . . . if it weren't so PATHETIC

You are inclined to apologize to your friends for driving an old-fashioned automobile,—but—you don't seem to have any compunctions about the continued use of all those antiquated machine-tools running in your shop.

Your 20-year-old planers are not even *"running"*—they are merely limping along, compared with a 1931-model Maximum Service planer which runs three times as fast.

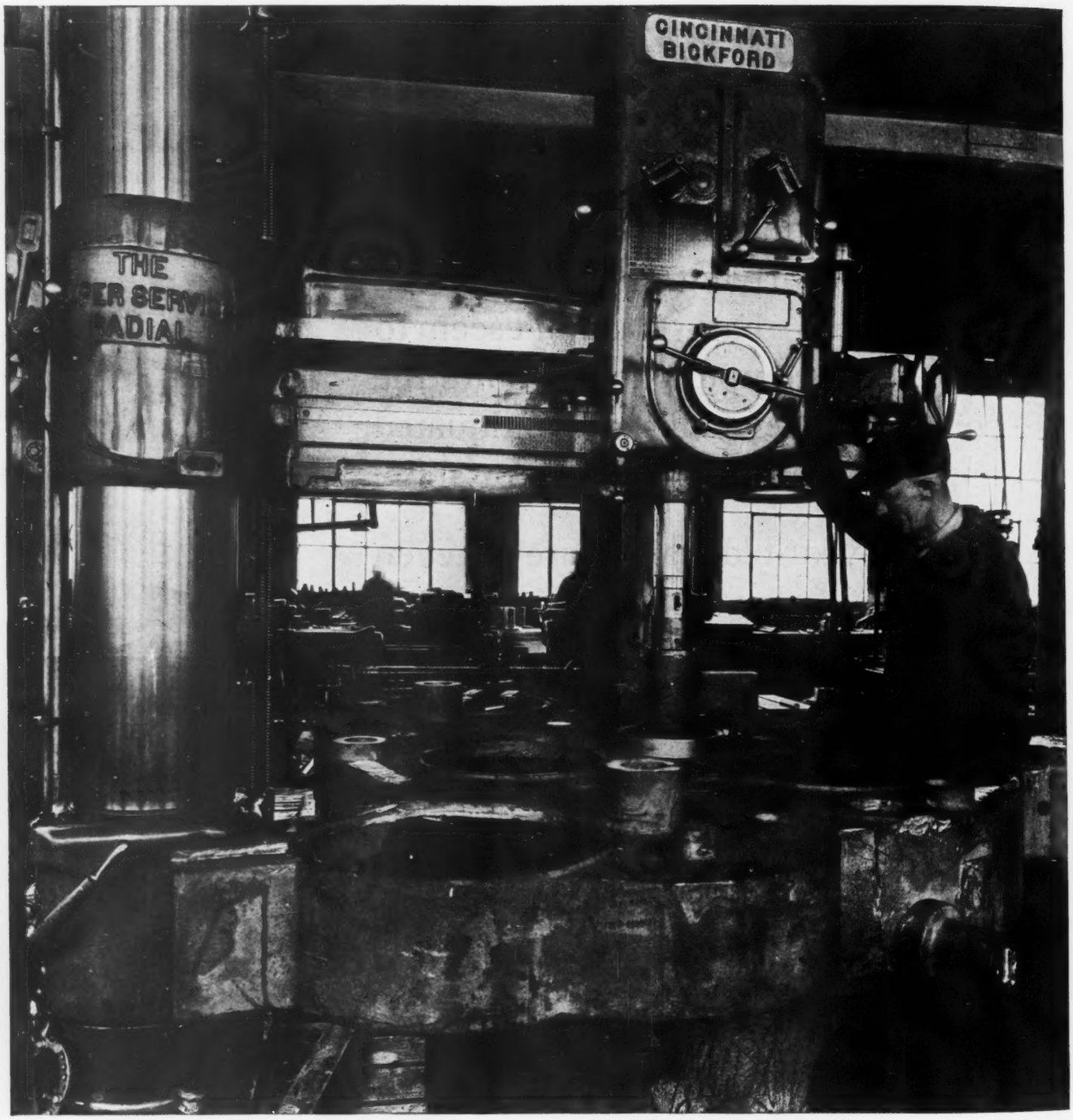
Speed is only one of many time- and labor-saving features that characterize

GRAY
Maximum Service
PLANERS

Open-Side and Double-Housing

THE G. A. GRAY CO.
CINCINNATI, OHIO

Will Your Radial Drill Do This?



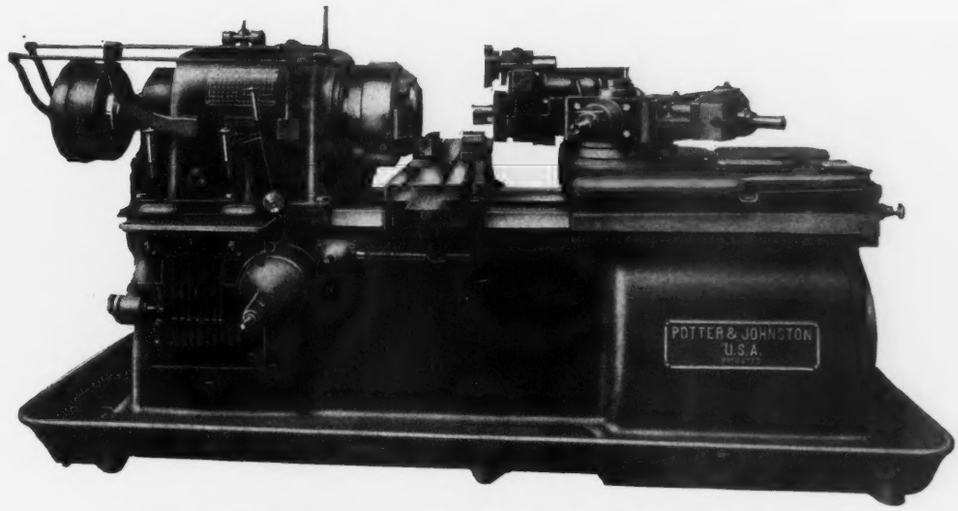
SUPER-SERVICE Radial at The Fenn Manufacturing Company, Hartford, Conn., turning the outside diameter of a boss 11½ inches in diameter and 2 inches long. Time—1¼ hours, previous time —2¼ hours, saving—44%! And accurate to within plus or minus .001″.

Write for the booklet "Leadership Calls Forth Leadership" and Catalog R-11A. Then you will have the facts concerning SUPER-SERVICE performance and construction.

The SUPER-SERVICE *Radial*

THE CINCINNATI BICKFORD TOOL COMPANY, CINCINNATI, OHIO

Accelerate Accurate Production with P & J Automatics!

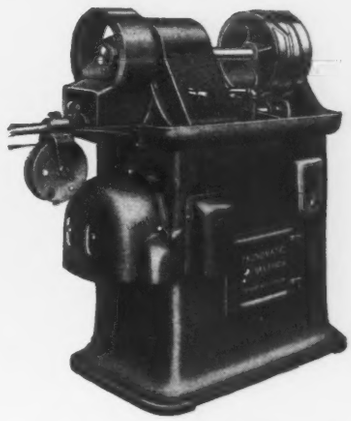


5-D POWER-FLEX AUTOMATIC CHUCKING MACHINE

THE Potter & Johnston Machine Company—pioneer builders of Automatic Chucking and Turning Machines—offers in the 4-D, 5-D and 6-D models, a line of tools which will automatically handle the drilling, boring, reaming, facing and turning operations on your duplicate parts from 3" to 20" in diameter.

With the exception of the chucking, the machines are entirely automatic in their operation, thereby permitting a division in labor costs.

Such up-to-date features as Timken Tapered Roller Bearings, hardened and ground steel ways, chrome nickel steel shafts and gearing, instantaneous automatic speed and feed changes, etc., are some of the many advantages found in these tools which enable them to produce work to commercial limits year after year.



EKONOMATIC
NUT MACHINE

P&J

DO IT
AUTOMATICALLY

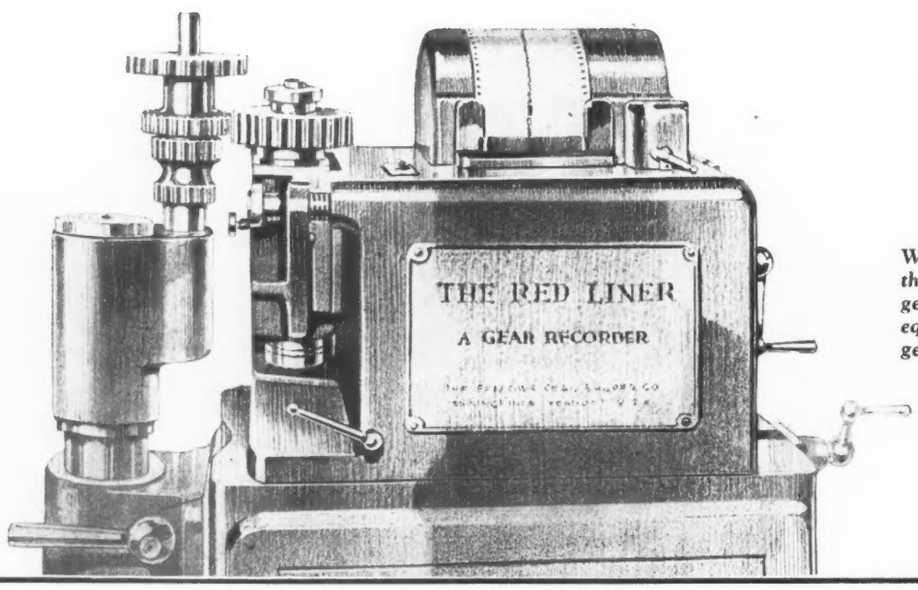
POTTER & JOHNSTON MACHINE CO.
Pawtucket, Rhode Island, U. S. A.

P&J

There is a definite border line of Safety

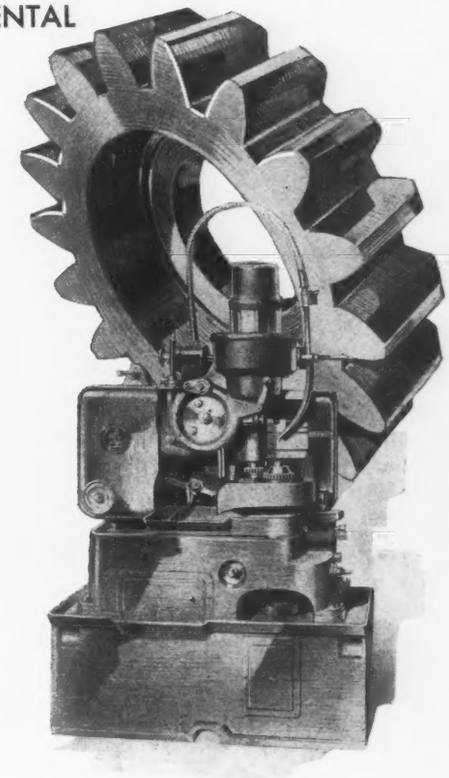
beyond which you cannot allow the cumulative errors in gears to go or the tooth surfaces will disintegrate under

IMPACT LOAD



While designed to verify the accuracy of Fellows-cut gears, the RED LINER is equally useful in inspecting gears cut in any other way.

CONTROLLED ACCURACY IS FUNDAMENTAL WITH THE FELLOWS METHOD



"Red Liner" inspection confirms the high percentage of acceptable gears and the overall economy of equipping to produce a minimum of rejects—with FELLOWS GEAR SHAPERS and ORIGINAL FELLOWS GEAR SHAPER CUTTERS.

• • **High speed gears MUST be accurate,** not to reduce noise (although accuracy is conducive to quiet operation), but vitally from the standpoint of durability. Such gears, heavily loaded, wear out long before the teeth break out.

• • **Wear becomes excessive** (granting the use of proper materials, mounting and lubrication) when augmented by inaccuracies. And not so much by errors in the individual teeth as cumulative errors which, at high speeds, build up IMPACT LOADS many times greater than the applied load. Tooth surfaces disintegrate and the gears wear out long before they break.

• • **There is no assurance** that gears will be durable simply because you know there are no excessive errors in the individual teeth.

• • **The safety limit of cumulative errors,** determined by speed, pitch of tooth and material is of vital importance. Knowing this limit, the "RED LINER" will tell you at a glance just when your gears are reaching the border line of safety.

• • **The "Red Liner"** functions as an insurance protection of your reputation as a manufacturer of DURABLE GEARS. Now is the time to investigate! Write for booklet No. 11—or, have one of our engineers call and explain this 20th Century gear inspection machine. THE FELLOWS GEAR SHAPER COMPANY, Springfield, Vermont, U. S. A. *(or Detroit Office, 616 Fisher Building).*

Yours for the asking . . .

FELLOWS
~ GEAR SHAPERS ~
AND "RED LINER" INSPECTION

THAT'S PROGRESS!

Although a crude practice, iron was produced thousands of years ago. Ore was poured on a hot fire, smelted into iron pellets, and hammered into weapons, tools, etc.

ANCIENT Assyrians and Babylonians knew iron. Crude furnaces made crude iron for crude implements.

Fifteen years ago considerable hand labor was involved in forming iron. Today, however, continuous mills speed production and lower costs. That's progress!

» » »

Progress and refinement in the precision grinding field parallels this development. Modern Cincinnati Precision Grinders reduce costs 20% to 75%, boost production and improve accuracy to give users maximum profits.

In a prominent railroad shop, for example, a Cincinnati Plain Self-Contained Grinder is saving $200.00 on each Diesel engine crankshaft it grinds. Accuracy has been improved and main and pin bearings on a six-cylinder crank are ground in 6½ hours.

Replacement of obsolete equipment with modern Cincinnati Grinders invariably results in exceptional production increases, cost reductions, and accuracy improvements. Improve the profit-earning ability of your shop with modern tools and methods.

CINCINNATI GRINDERS INCORPORATED

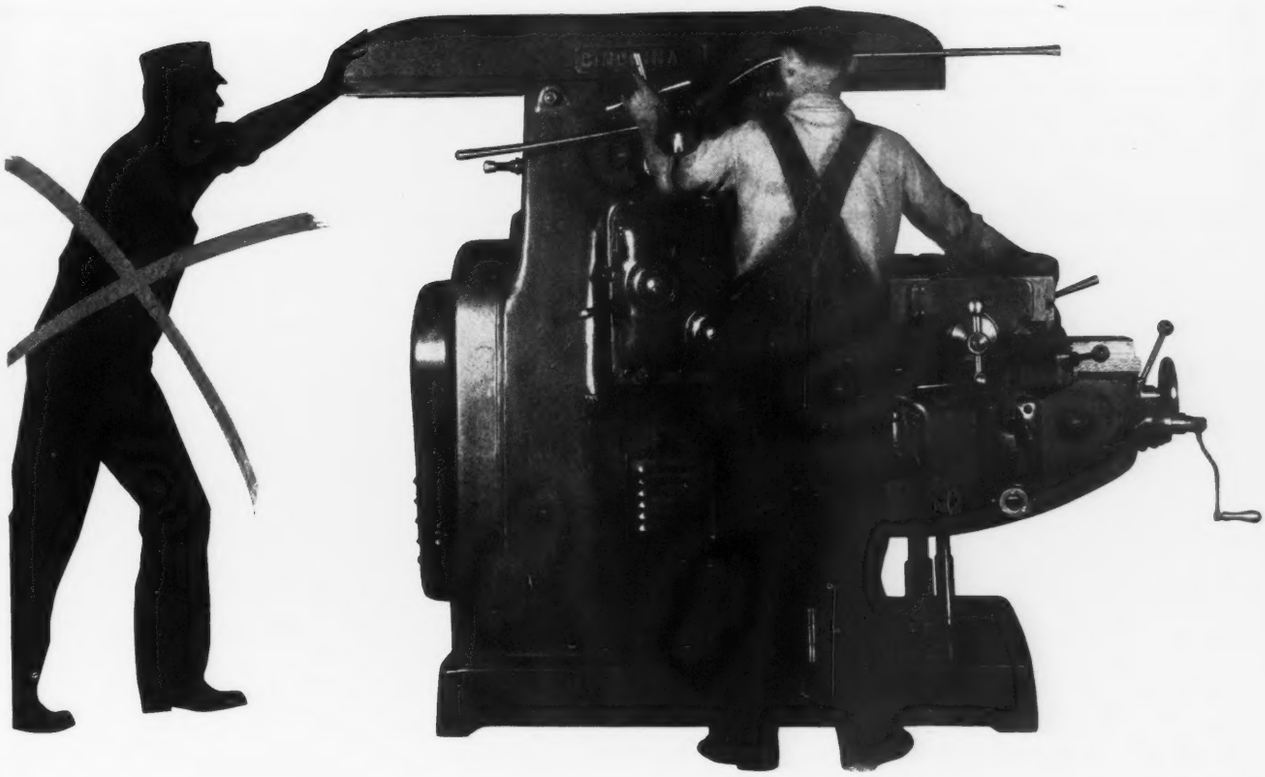
CINCINNATI, OHIO, U. S. A.

CINCINNATI

Cincinnati 14" x 72" Plain Self-Contained Grinder.

Patented

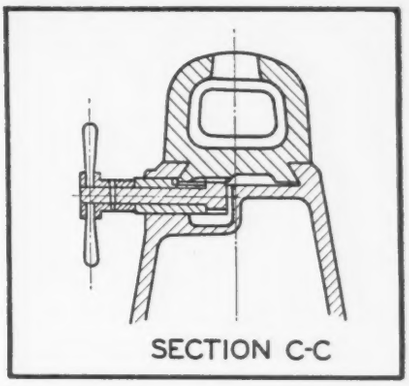
Today the continuous mill process speeds the production of iron sheets. Hot ingots pass in a continuous line through mills and furnaces acting successively on the product—rapidly, economically, accurately.



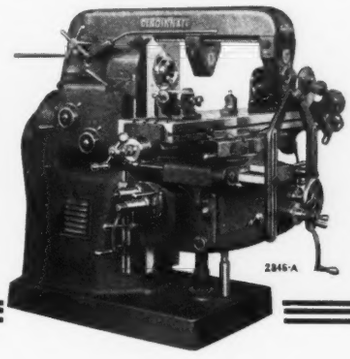
He likes it...

ASK any operator of Cincinnati Millers and he will tell you he likes the Cincinnati Rectangular overarm—and why! He doesn't have to shove or push the overarm. Just an easy twist of the pilot wheel slides the overarm in its scraped bearings, into the exact position that he wants. There's no pushing or pulling on a heavy member, high above the floor—no running around to see if he's lucky enough to stop it where he wanted to—no handicaps—just a twist of the pilot wheel.

It really means faster set-up with greater convenience in the toolroom or manufacturing shop. More time for actual milling—lower costs for you. That's why you should consider it as one of the important features on your next milling machine.



The Rectangular Overarm is adjusted by means of a pinion on the pilot wheel shaft and a rack cut into the under side of the overarm.



Cincinnati No. 2 Universal Miller

The Cincinnati Milling Machine Co.

Cincinnati, Ohio, U. S. A.

CINCINNATI

Published by
Sundstrand Machine Tool Co.
Rockford, Illinois

Volume II, No. 8

ENGINEERED EXAMPLES FROM THE

Here's Economy
One Stub Lathe

Never decide that any manufacturing milling or turning job cannot be done on a Rigidmil or Stub Lathe respectively, until you have put the problem up to the Sundstrand Engineered Production Department. For instance, see the following paragraph which might sum up the approximate reaction to a suggestion for turning the Valve Plugs, shown in Fig. 1, on a Stub Lathe.

"Agreed, the Stub Lathe can get at these parts from three directions with multiple and formed tools—can pull the load and stand up under the battering of the heavy intermittent cut—can be changed readily from one size to another. Still, you're licked! We must have *one* machine that will handle 8 sizes ranging from 1″ to 6″ body diameter, and the 12″ Stub Lathe isn't long enough for the big ones. Besides, we want a semi-automatic machine with roller-bearing spindle and tail-center."

Engineered Production promptly designed a 12″ Stub Lathe with a longer bed, submitted a

Fig. 1. Eight different sized valve plugs turned on high production basis by one Stub Lathe.

PRODUCTION
SUNDSTRAND FILES

Lathes
Milling Machines
Centering Machines
Balancing Tools

August, 1931

and Efficiency Does the Work

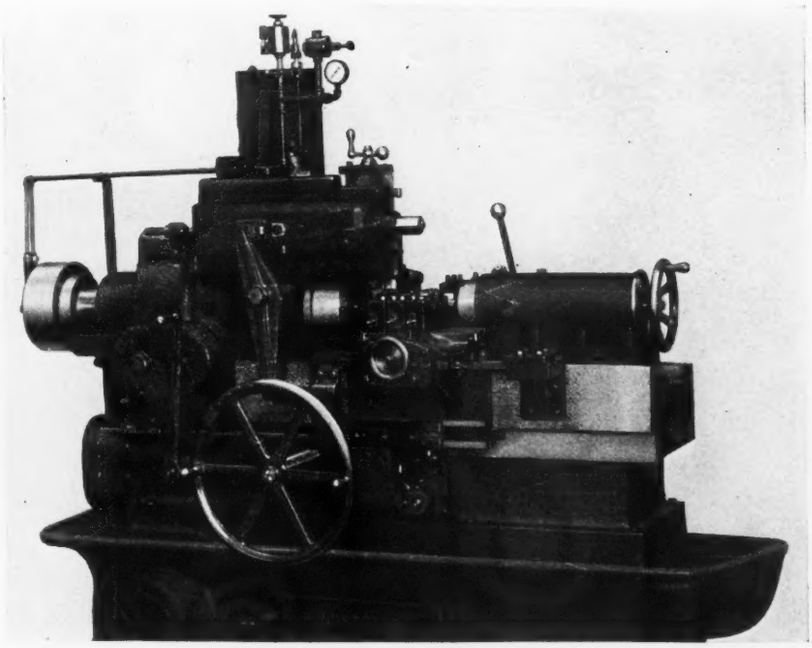


Fig. 2. 12″ Stub Lathe as arranged for producing line of valve plugs economically and efficiently.

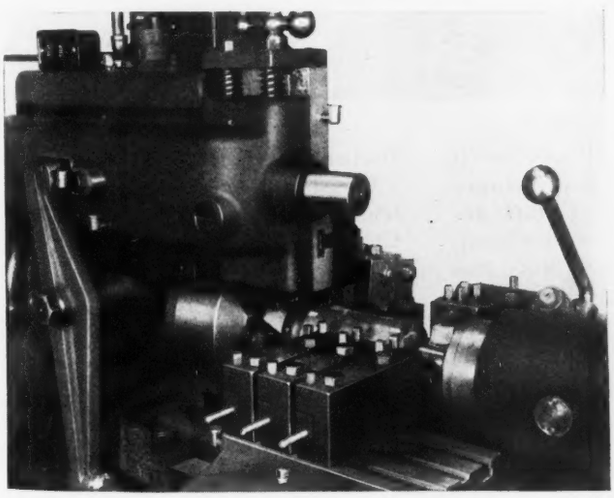


Fig. 3. Detail of tooling and overhead slide.

proposal that met all of the requirements—and it was accepted. The finished machine is shown in Fig. 2, a close-up of the overhead slide and the tooling in Fig. 3. This Stub Lathe turns all eight sizes; can be changed quickly from one size to another; provides high production on all of them at very low cost and requires only about 15% of the operator's time! So, you see, Engineered Production won out here as it has in hundreds of other examples on record. Details of the job shown, or a production proposal on your own work, sent promptly on request.

No matter *what* confronts you in milling or turning—be sure to see what Sundstrand Engineered Production can suggest. Moreover, you can—

Put a STOP to losses resulting from the use of obsolete equipment, by consulting

SUNDSTRAND MACHINE TOOL CO. S ROCKFORD, ILLINOIS U.S.A.

A Drop in the Bucket

YOUR CASTINGS . . . *made with Charcoal Pig Iron have* . . . GREATER DENSITY · ADDED TOUGHNESS · MORE STRENGTH · LESS SHRINKAGE · LESS SCRAP LOSS · GREATER UNIFORMITY · EASIER MACHINABILITY . . . *and you get higher quality finished products.*

—but WHAT a DROP !

Just a small change of iron in your castings— but it may mean the difference between profit and loss

Castings that break and reach the scrap pile before their time —costly for you. Breakdowns due to unforeseen strains on your product, making replacements necessary — costly for your customer.

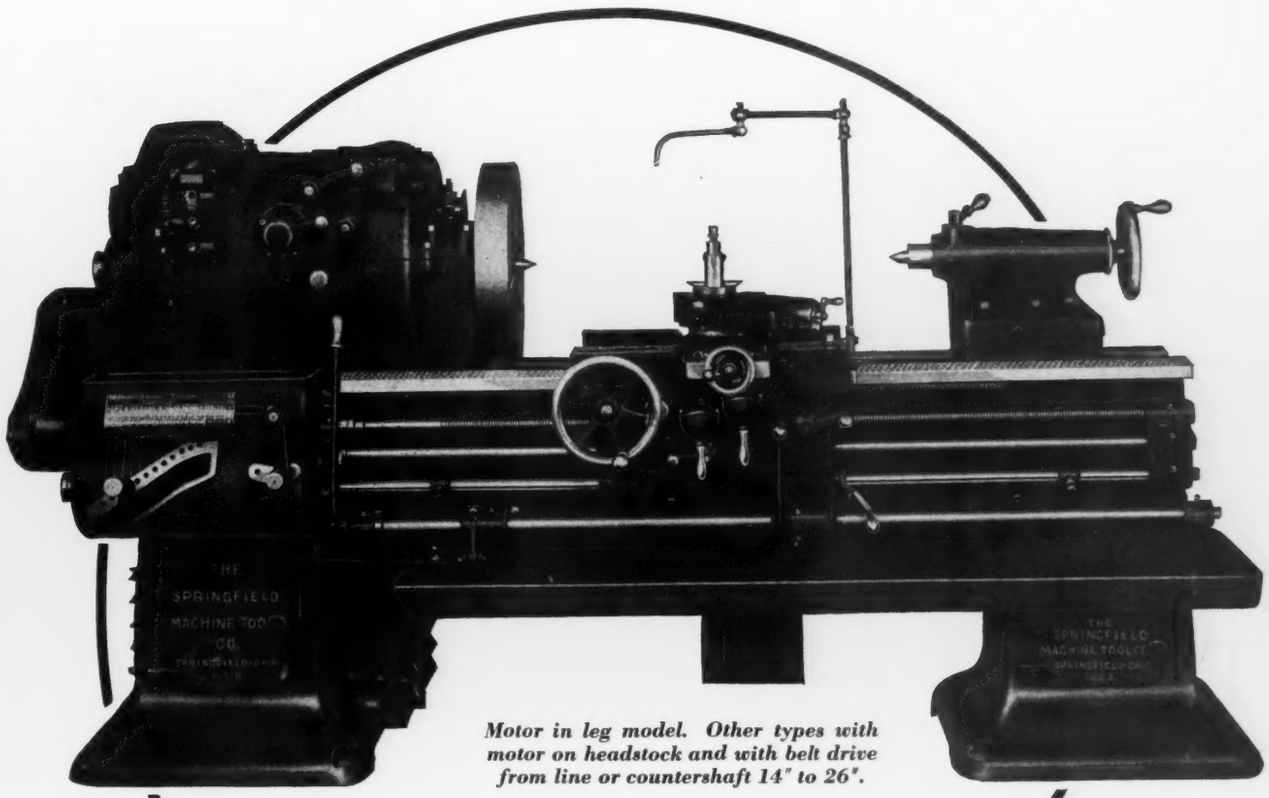
A little added strength in your castings would prevent these, nine times out of ten.

You'll get that extra strength with a portion of Superior Charcoal Pig Iron in the mix. In addition, you'll get castings easier and cheaper to machine, castings that are tougher, denser, more uniform. And your foundry will have less scrap loss—which means savings for you in the long run.

Make sure of good castings. Include in your specifications "All castings must contain at least 15% to 20% Superior Charcoal Pig Iron."

SUPERIOR CHARCOAL IRON CO.
Grand Rapids, Mich.
Debevoise-Anderson Co., Inc.
Eastern Representative
New York · Boston · Philadelphia

Superior Charcoal Pig Iron



Motor in leg model. Other types with motor on headstock and with belt drive from line or countershaft 14" to 26".

More Quantity—Better Quality

Better work, and more of it—that's why buyers of Springfield equipment so seldom switch to another machine when it's time to replace, or add to the line.

A Springfield combines production capacities equal to the most extreme demands with unusual precision that is never absent. Add to those qualities wide range, low operating cost and dependability to the *n*th degree—and you have some mighty good reasons for writing for further details.

Twelve speeds, directly selected, from 14 gears. No idle gears ever in mesh.

All journals (except main spindle) ball bearing, including thrust.

Noiseless and chatterless head, free from vibration.

Handy adjustment of main spindle bearing without removing cover or caps.

Concentrated control.

Greater accuracy—production. Less power consumption.

THE SPRINGFIELD MACHINE TOOL CO.

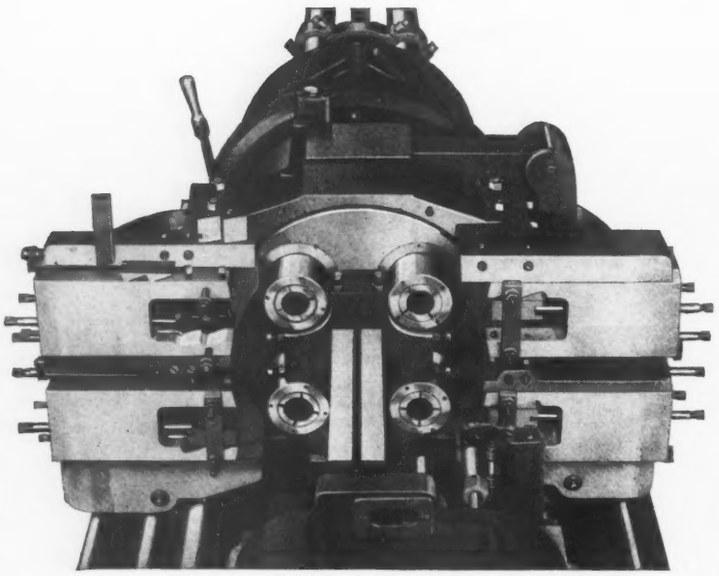
Manufacturers of Springfield Lathes and Shapers

631 Southern Ave., Springfield, Ohio

SPRINGFIELD

Ball Bearing Geared Head

• ENGINE LATHES •



Wide-Open Accessibility

◆ ◆ ◆ ◆ ◆

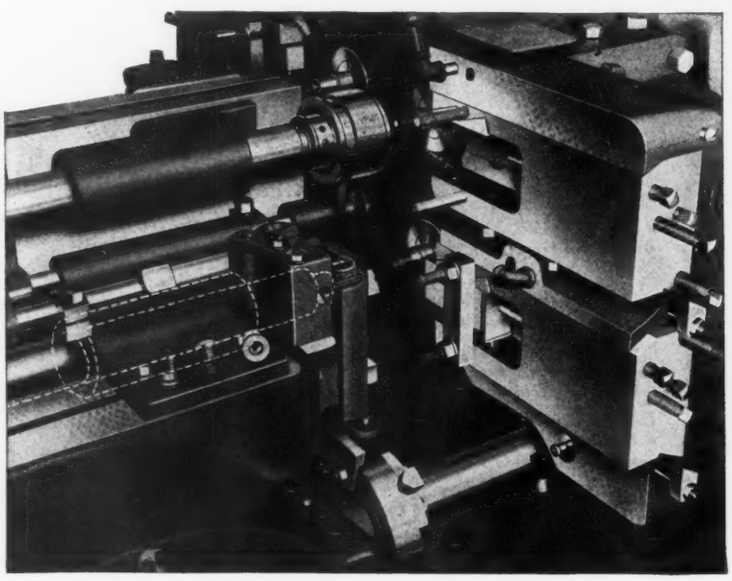
To a degree never before attained in a Four-Spindle Automatic

THE GREENLEE Four-Spindle Automatic is purposely designed to be the handiest and quickest to set up of any multiple-spindle machine. This feature makes the machine espesially valuable to users, since operators can get at all tools and spindles without being hindered by troublesome piping, overhead mechanisms, etc.

The intermittent gearing, which operates the tool slide on the Greenlee, is carried between the ways of the bed and meshes with a rack on the bottom of the slide. This eliminates the usual drum cam commonly used for feeding purposes and the overhead ways for guiding the tool slide. Feed changes are controlled by pick-off gears that are easily reached and by a feed-adjusting dog on the main worm wheel.

All four of the forming slides on the Greenlee have independent feed. Each has its own cam which can be easily removed for changing feeds. All cams are interchangeable for all spindle positions. The usual piping and flexible hose have been eliminated by having a built-in coolant system which distributes the coolant through the tool and forming slides direct to the various cutting tools. The bodies of all tool holders are provided with passages so that the flow of coolant can be directed to the cutting edges of the tools.

Every manufacturer using machines for bar work should be familiar with the Greenlee. Its new features, accessibility and faster production time will make money for you.



Set-up showing threading with die head in third position and tapping in fourth position. Dotted lines show the tapping spindle. Notice how accessible all tools are.

Write for New Descriptive Bulletin on Greenlee Automatics

Builders of High-Speed Multiple-Spindle Drilling and Tapping Machines.

Greenlee BROS. & CO.
ROCKFORD, ILLINOIS, U.S.A.

Four-Spindle Automatics; Special Cost Reducing Machinery.

The Morse Line includes High Speed and Carbon

DRILLS
REAMERS
CUTTERS
TAPS AND DIES
SCREW PLATES
ARBORS
CHUCKS
COUNTERBORES
MANDRELS
TAPER PINS
SOCKETS
SLEEVES

Cut the cost of manufacture with these high production tools

SMALL tool waste, which may have gone unnoticed a few years ago, stands out like a sore thumb in these days of production economies.

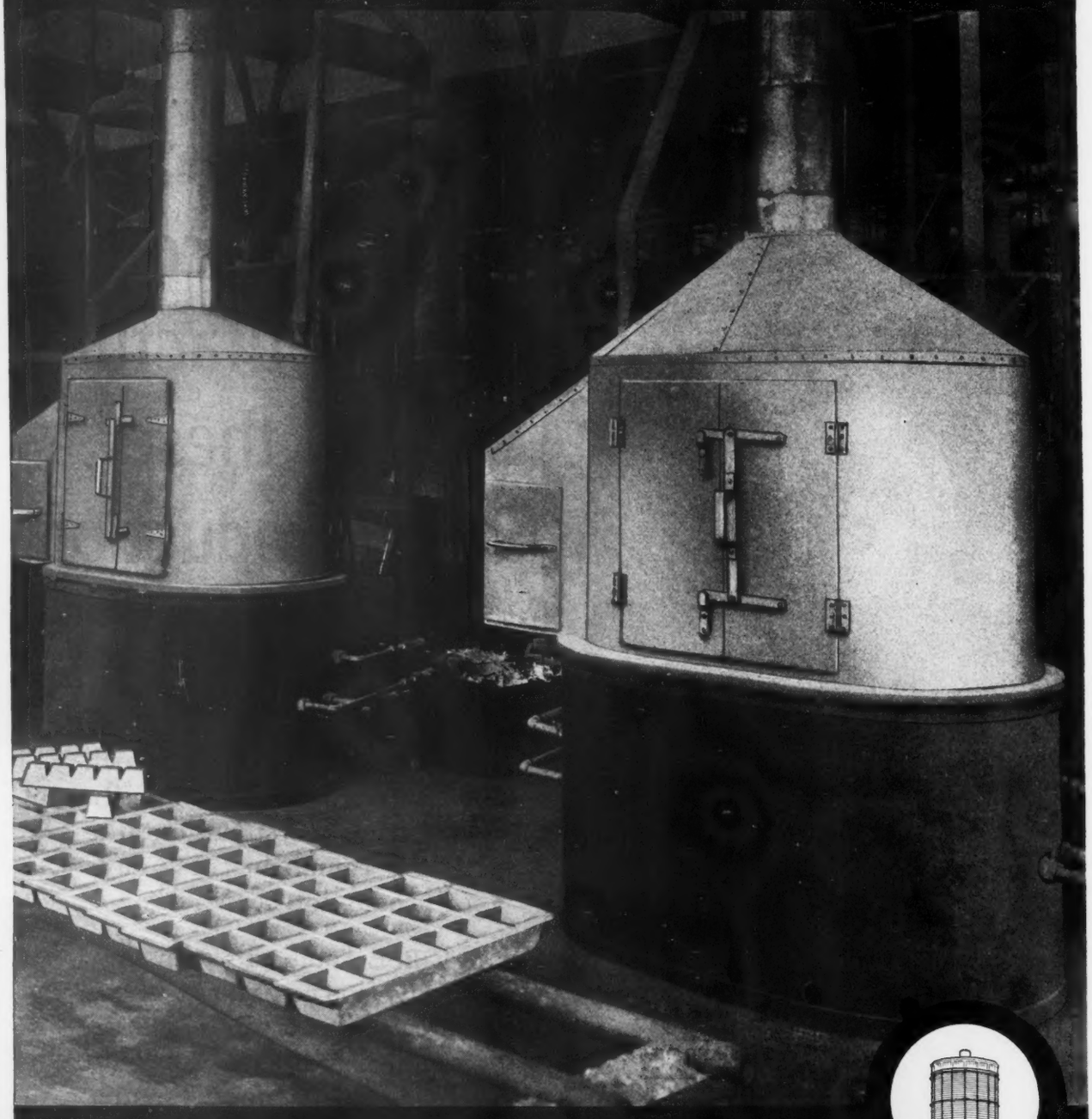
MORSE Tools will keep your production costs down to bed rock. Their savings are the result of uniformly long life between sharpenings, uniformly high cutting ability.

MORSE

TWIST DRILL & MACHINE COMPANY

NEW BEDFORD, MASS., U.S.A.

METAL REFINING



Gas is acknowledged the best fuel for metal refining. Temperature is accurately controlled. Gas promotes longer pot life; there are no combustion products to interfere chemically; and the recent development of new equipment makes for increased economy. Send for the new book "Gas Heat in Industry".

AMERICAN *Gas* ASSOCIATION

420 Lexington Avenue, New York

GAS FOR HEAT WHEREVER HEAT IS NEEDED

Beware

of Imitations

When you're buying
Quick Change Chucks
look for the name

MODERN MAGIC CHUCK

THE STANDARD FOR 30 YEARS

To get the
GENUINE
look for the name
MODERN Tool Works
on the Chuck

The
MODERN
MAGIC CHUCK
Has Thirty Years
of Proven
Performance
Behind It

Modern Tool Works

ROCHESTER, N. Y., U. S. A.

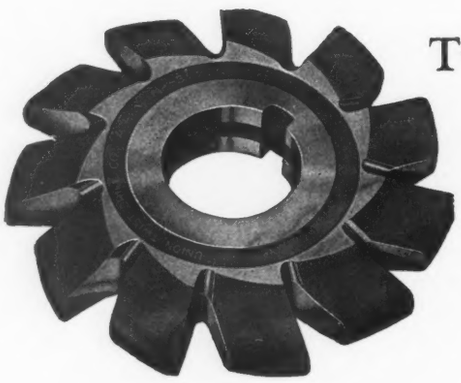
Division of Consolidated Machine Tool Corporation of America

YOUR MACHINES *deserve*

UNION

▼ *Modern Cutting Tools* ▼

Milling Cutters
Gear Cutters
Reamers



Twist Drills, Dies
Screw Plates
Taps, Hobs

Modern machines deserve modern tools—tools that cut fast and deep—tools that have uniformity and long life—in short, Union Tools.

Extreme care is exercised in the selection of steel for Union Tools—and in the hardening and annealing processes and grinding of teeth. They are designed to and do give *maximum* service.

May we once again urge you to standardize on Union!

Catalog of Complete Line on request.

UNION TWIST DRILL CO., Athol, Mass.

Mansfield, Mass.
New York, 62 Reade Street

▼ ▼

Chicago, 11 So. Clinton Street
San Francisco, 121 Second St.

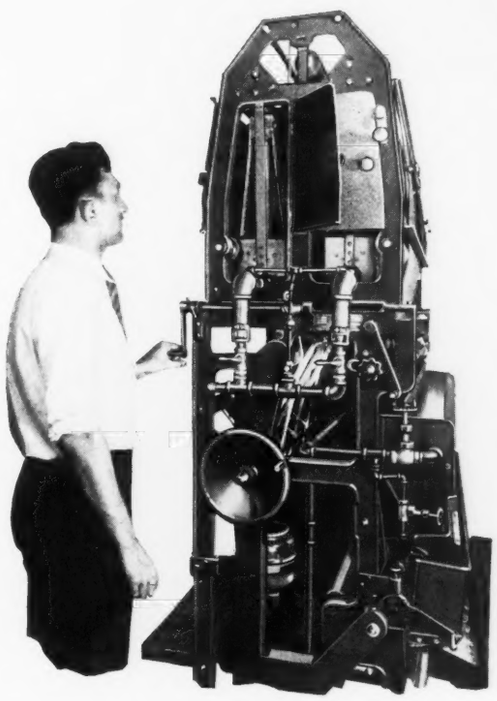
▼ ▼

Derby Line, Vt.
Rock Island, Quebec

A NEW PEASE BLUE-PRINTING MACHINE

MODEL "25"

produces high grade Blue-Prints!



The new dryer on Model "25" is low in height with twin radiator heating units that can be equipped with either gas or electric heating elements. It is an enclosed oven type dryer with sliding panels and side doors which enables the operator to overcome difficulties in temperature, humidity, and drafts in drying prints.

WHO wants a wrinkled Blue-Print, Negative, Blue-Line or Brown-Line Print? Nobody—we feel sure!

Well, you can practically forget about "curling around the edges," "ocean waves" and "distortions" on the prints you turn out if you have a Model "25." Here is a new, economically priced Pease "Peerless" Continuous Blue-Printing Equipment that struck instant favor with a great many manufacturers simply because it emphatically proves that ***good drying*** is no less important than ***good printing.***

You will be amazed at the high quality of work you can turn out with the Model "25" at any speed from 4 inches to 12 feet per minute. Blue-Prints, Negatives, Blue-Line and Brown-Line Prints are uniformly printed, fully developed, thoroughly washed and evenly dried without wrinkles or distortion.

Ask for Pamphlet MP-522

THE C. F. PEASE COMPANY

822 North Franklin Street, Chicago, Illinois

PEASE

BLUE-PRINTING MACHINERY

For the Sake of Efficiency . . .

Let's stop fussing around with this parts cleaning proposition—if it's got to be done, let's do it the cheapest, quickest and most efficient way possible. And it can be done quickly, cheaply and efficiently with a

COLT AUTOSAN
Metal Parts Washing Machine

Three big reasons why Colt Autosans have been installed by leading manufacturers—

1. They are available in models to meet practically every cleaning need.
2. They are designed by an engineering staff that understands the problem involved.
3. They are built by one of the largest, oldest and most responsible manufacturers in the country.

Let us tell you what we can accomplish for you in the way of cleaning and drying efficiency and economy. Write, without obligating yourself, to

COLT'S PATENT FIRE ARMS MFG. CO.
Autosan Machine Division
HARTFORD, CONN.

PUT A COLT AUTOSAN ON THE JOB!

Model 1-D is shown at the left —a two-tank standard conveyor model designed to handle medium and large pieces. Small parts may also be cleaned in baskets. Washes and rinses—equipped with four sets of Direct Action sprays.

COLT AUTOSAN

METAL PARTS CLEANING and DRYING MACHINES!

ARMSTRONG TOOL HOLDERS Are Used in Over 96% of the Machine Shops and Tool Rooms

Apprentices are taught the use of ARMSTRONG TOOL HOLDERS at the home of the "House of Magic"

Boring Out Lead Press Point with an ARMSTRONG Adjustable Boring Tool at the Apprentice Training Room, General Electric Co., Schenectady, N. Y.

The selection of tools for tool room and manufacturing processes at the great General Electric plant at Schenectady, N. Y., is as would be expected, based on scientifically accurate knowledge of tool performance. Likewise the training of apprentices is studied, and carefully directed—is carefully planned to make them efficient operators, schooled in the most efficient, most practical methods.

It is significant to note that both in training and in practice ARMSTRONG TOOL HOLDERS play an important part in the shops of this model plant, that where tools are selected after exhaustive tests on a basis of predetermined efficiency, that ARMSTRONG TOOL HOLDERS of all types are used.

ARMSTRONG
Adjustable Boring Bar

Easily adjustable to different heights, even to various angles (for boring, facing or turning). Takes bars of many sizes—hollow bars of high carbon, seamless tubing, extremely rigid.

The Armstrong System of Tool Holders provides permanent tools that save All Forging, 70% Grinding and 90% High Speed Steel, for all operations on Lathes, Planers, Slotters and Shapers.

ARMSTRONG BROS. TOOL CO.
"The Tool Holder People"
313 N. Francisco Ave., CHICAGO, U. S. A.

London Branch:
ARMSTRONG BROS. TOOL CO., LTD.
35 Upper Thames St., London, E. C. 4, England

ARMSTRONG
Tool Holders
Lathe Dogs
"C" Clamps
Ratchet Drills
High Speed Steel Bits
Drop Forged Wrenches
Drill Posts
Planer Jacks
Machine Shop Specialties

ARMSTRONG BROS.
Dies and Stocks
Pipe Cutters and Wheels
Pipe Vises
Pipe Wrenches and Tongs

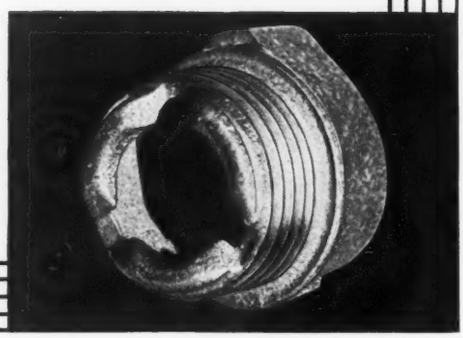
Buy ARMSTRONG TOOLS from your Supply House

WRITE for Catalog B-27. Shows, describes and prices all ARMSTRONG Tools.

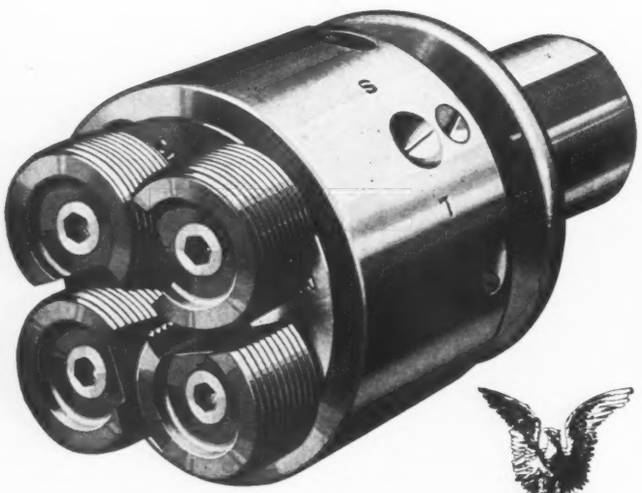
ARMSTRONG

TRADE MARK REG. IN U.S. PAT. OFFICE

CAN YOU DO THIS ?



A CONNECTICUT machine company is threading 1400 of these connectors per hour on a hand-operated drill press using a NAMCO "DR" Die Head with Circular Chasers. The $^{13}/_{16}$" "DR" Die threads these pieces from the rough malleable iron casting, cutting a $^{1}/_{2}$" straight pipe thread. The above company is getting 25,000 finished pieces from one chaser grind. The cutting agent used is a soluble oil. NAMCO Die Heads with Circular Chasers are giving similar performance throughout the country. Can you get production such as this from the chasers you are now using?



NAMCO *Style "DR" Die Head with Circular Chasers*

Bulletin* PD-M *gives complete* NAMCO *Circular Chaser Facts

REG. U.S. PAT. OFF.

THE NATIONAL ACME CO.

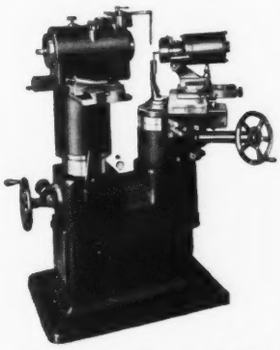
Cleveland, Ohio • *Branches*—New York Chicago Detroit • *Representatives in Principal Cities*

OLIVER EQUIPPED

To Insure Economy on Production Tools

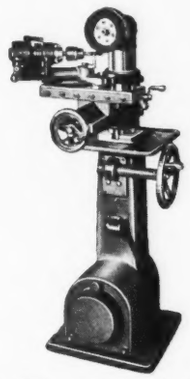
The Oliver of Adrian Die Making Machine

for sawing out, filing and lapping dies, templates, stripper plates, gages, cams, etc. Nine styles, three types for bench or pedestal and belt or motor drive. Capacity ranging from 1¼" on bench and small pedestal type, 2" for large pedestal type and 3" on the New Heavy Duty.



The Oliver No. 2 "ARC" Face Mill Grinder

grinds the face, cutting edge and periphery of a milling cutter blade, including a perfect radius from 0" to 2" on the corner, in **one operation**—another Oliver opportunity for tool room savings. (100% efficient on grinding Tungsten-Carbide tipped face mills.)



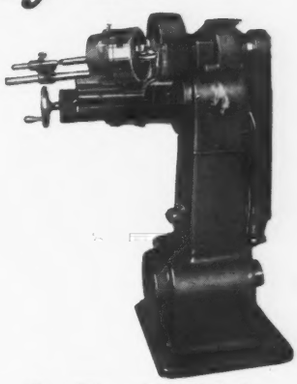
The Oliver Tap Grinder—

Will quickly and accurately grind a tap with the correct amount of clearance. Cam control assures uniform grinds.

Oliver machines are especially designed to keep modern tools functioning at maximum efficiency.

Correctly ground twist drills, taps, milling cutters, tungsten-carbide-tipped tools, etc., are just like new in their production, accuracy and capacity. They last longer, give more satisfactory service and so, in the long run, *cost less.* The Oliver machines shown here insure correct tool grinding—real tool economy.

Ask us for further details

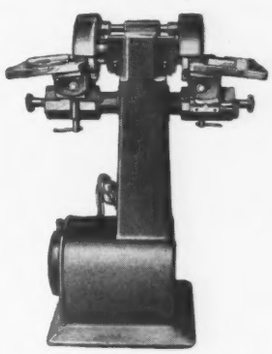


The Oliver Drill Grinder—

The only drill grinder that will automatically grind twist drills. It produces the patented Oliver drillpoint. For drills 3/16" to 3" diameter.

Oliver Drill Point Thinner—

Corrects Out-of-Center, Out-of-Index, Bent and Too-thick-web condition of drills up to 3" dia. Indispensable for reclaiming discarded drills.



The New Oliver Tungsten-Carbide Grinder

with two 9" grinding wheels, two tilting tables, two protractors and a diamond dresser; one size, motor driven, arranged for wet or dry grinding. A sturdy, efficient, modern grinder for the most modern cutting tools.

OLIVER INSTRUMENT COMPANY

1410 E. Maumee Street **ADRIAN, MICHIGAN**

Specialists in Tool and Cutter Grinding Equipment

"Precision Built"

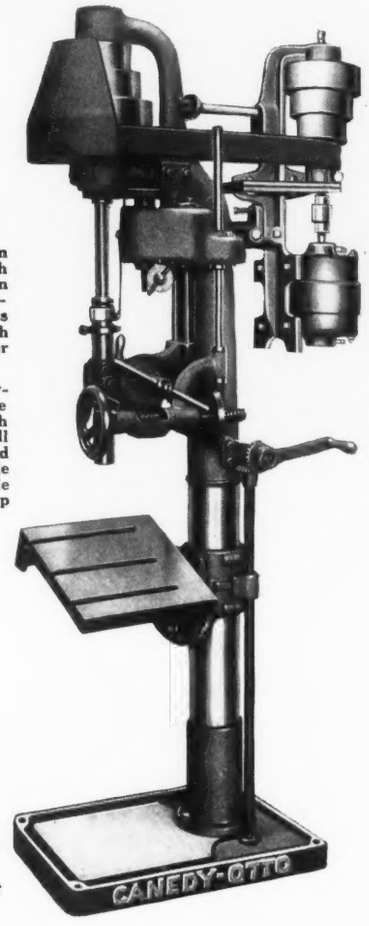
CANEDY-OTTO DRILLING UNITS

If You DRILL *check this equipment!*

It pays to check over the Canedy-Otto line before installing any type or size of drilling equipment. You'll find C-O machines equal to the best in design, construction and capacity — and they're priced considerably lower than other tools in their class.

The machines shown here are typical of the line, but only a small part of it. Ask for our catalog—it contains much that will interest you.

CANEDY-OTTO MANUFACTURING CO.
CHICAGO HEIGHTS, ILLINOIS



The C-O 17" Sliding Head Motor Driven Drill

Direct belt drive from motor to spindle, which is provided with Timken Roller Bearings. Construction throughout insures smooth operation with minimum wear and power consumption.

Self-feed is accurate, powerful and simple; there are four changes of feed which can be made while the drill is in operation. Furnished with square tilting table or round oil grooved table and delivered set up "Ready for the Job."

The C-O 14" High Speed Sliding Head Sensitive Drill

A precision production tool with capacity to 5/16". High grade ball bearings throughout, rotating parts well balanced and counter balanced spindle, combine for smooth, sensitive, uniform operation. Vertical type motor adjustable for belt tension reduces friction and power waste. Spindle speeds 3400, 5600, 10,000 R.P.M. Delivered "Ready for the Job."

The C-O 14" Sliding Head Sensitive Floor Drill

Motor driven — equipped with Timken Roller Bearings, a fast, accurate, profitable drill for holes to ½". Spindle is equipped with annular ball bearing. Upright motor, adjustable to belt tension, eliminates idlers, pulleys, intermediate cone pulleys and twist and turn belt, eliminating friction and holding power consumption. Spindle speeds 400, 850, 1750 R.P.M. Shipped "Ready for the Job."

"Ready for the Job"

check these GEOMETRIC features

1. *Easy Shoulder Threading*—The chasers protrude through the face plates—a unique Geometric feature—permitting easy, close to shoulder threading.
2. *Rigid Chaser Support*—In "K" Type Die Heads the chaser is supported on all bearing sides, with the closing sleeve forming a solid wall of metal to back it up directly behind the cutting point.
3. *Hardened and Ground*—Special alloy steels, hardened and ground throughout are used in all "K" Heads. There's no case to wear through, you can't have brittleness—but you do have toughness, which means long wear.
4. *Positive Locking*—"K" Die Heads close with a snap, and stay closed until released at the predetermined point. Unusually broad locking surfaces assure this positive locking.
5. *Quick Chaser Removal*—Little idle time is necessary for changing chasers. In Styles K, KD or KJ press down a stop lever; in Styles KH and KL pull up a stop plunger—and chasers can be picked out with the fingers.
6. *Easy Adjustment for Size*—Loosen a set screw and turn adjusting ring—that's all there is to adjusting a Style K, KD or KJ. Depress the plunger and turn adjusting ring for Styles KH and KL.
7. *Interchangeable Chasers*—Chasers are interchangeable throughout entire Geometric "K" line—made to fit five distinct types of die heads.

The "K" Type of Head offers a complete line of Tools—Rotary, Stationary, Solid Adjustable—one for nearly every threading job.

"K" *type* Die Heads

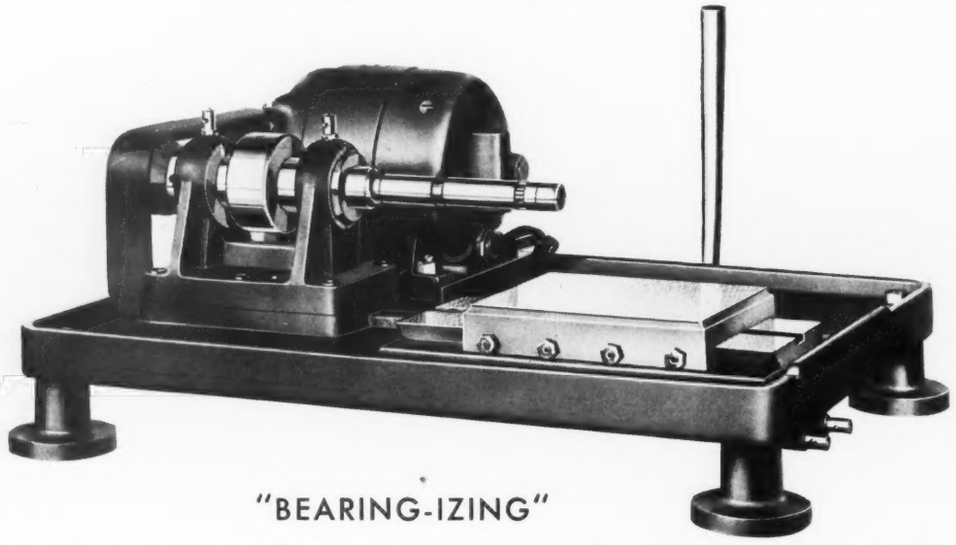
GEOMETRIC TOOL CO.
New Haven, Connecticut
Also manufacturers of over 30 years' standing of Collapsing Taps and Threading Machines

Junior

A COMPANION "BEARING-IZER" OF THE BENCH TYPE

The Junior has all of the mechanical excellence of the MASTER "BEARING-IZER." It fulfills the popular demand for a machine of adequate proportions to "BEARING-IZE" small units and still prove an economical installation in any department performing operations on internal surfaces.

The machine is self-contained and has a capacity to "BEARING-IZE" holes up to 1" in diameter, depending on the size and contour of the unit to be "BEARING-IZED" and the depth of the hole.



"BEARING-IZING"

is machine applied PERMANENCE. By internal swaging and rolling, the inevitable irregularities caused by even the finest reaming or boring operation, the "Bearing-izer" produces a glassy wear-resisting surface, comparable only to surfaces glazed by months of actual use.

"Bearing-izing" is performed in the number of seconds other finishing methods require minutes to accomplish and is applicable to Cast Iron, Aluminum, Bronze or Steel.

"BEARING-IZING" TOOL

MASTER "BEARING-IZER" CAPACITY UP TO 2½" DIAMETERS

COGSDILL MFG. CO.

DETROIT, MICHIGAN

COGS DRILL

COGSDILL MANUFACTURING CO.
DETROIT, MICHIGAN

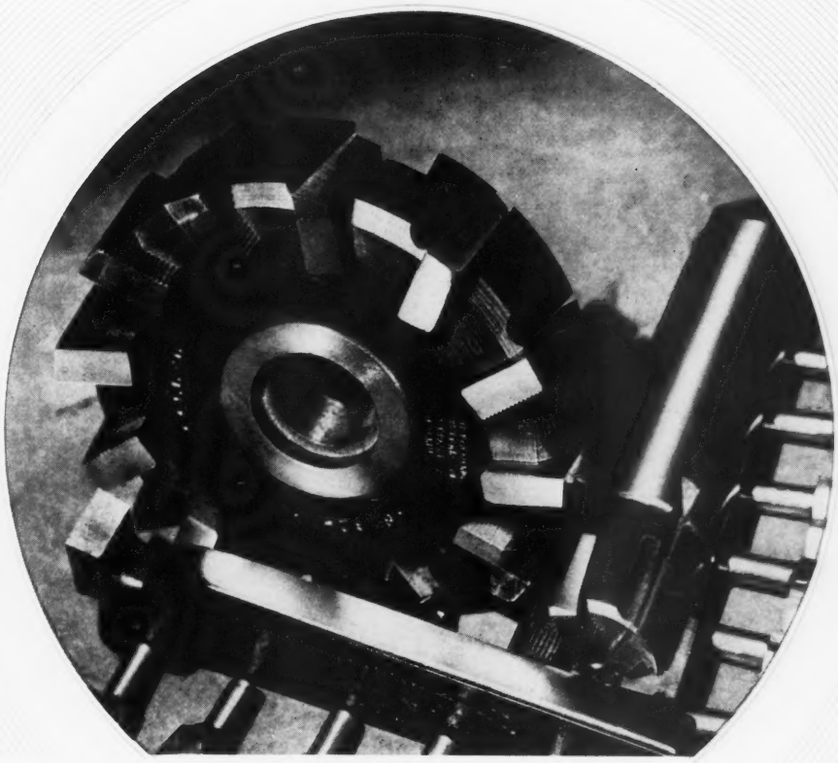
Gentlemen: Please send me the full details of "Bearing-izing" and a copy of your catalog, "Tools of Distinction."

Name.....

Address.....

Firm.....

Position.....



A TESTIMONIAL that wasn't paid for—

● *A large New England manufacturing organization* which is not in the habit of handing out bouquets, wrote:*

"We use the O. K. tool holders on our lathes, planers and boring mills because of economy as compared with solid forged tools, strength as compared with other tool bit holders, and flexibility and ease of operation in set-up and production.

"We use the milling cutters because of low cost and economy of up-keep. We are pleased with the wearing quality of the blades under severe conditions."

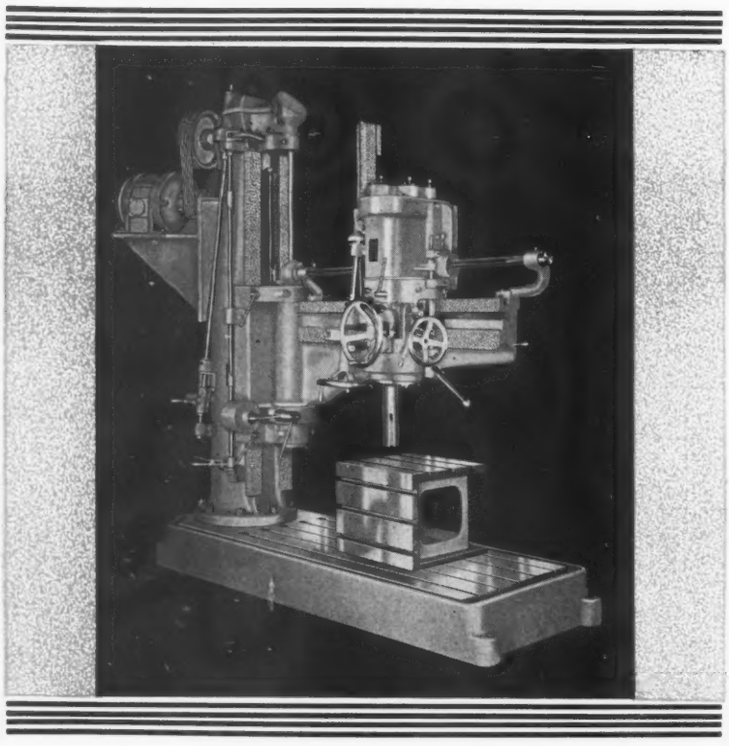
This is another specific instance of "Satisfaction through Service"... an O. K. selling policy that you should investigate. Inquiries regarding our engineering facilities involve no obligation. Send for a copy of "Cutting Costs With Cutting Tools"... free!

THE O. K. TOOL COMPANY, INC.

SHELTON ■ ■ ■ ■ ■ CONNECTICUT

*Name on request

BRITISH REPRESENTATIVE: Richard Lloyd & Co., Ltd., Birmingham



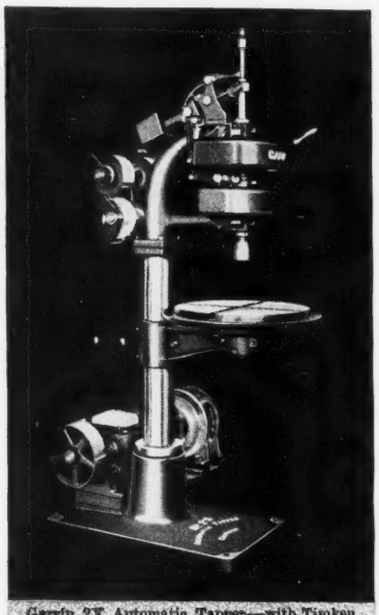
THE BIG 4 WESTERN LINE

A Powerful, Fast, Smooth Working Radial Drill

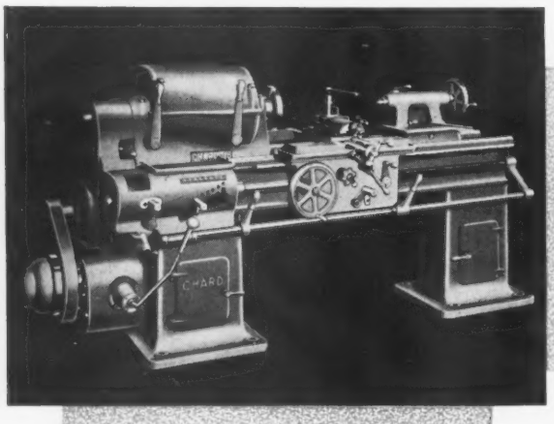
The Western "Low Hung Drive" Radial Drill with drive close to the point of action (entirely eliminating torsional strain on the spindle). Texrope Motor Drive, Twin Disc Clutch, Timken Tapered Roller Bearings and other features insure the smooth efficient drilling that is characteristic of this machine even on the biggest holes.

Details of this modern radial and the rest of the Big 4 Western Line are bound to be interesting. May we send them?

WESTERN MACHINE TOOL WORKS
HOLLAND, MICH.

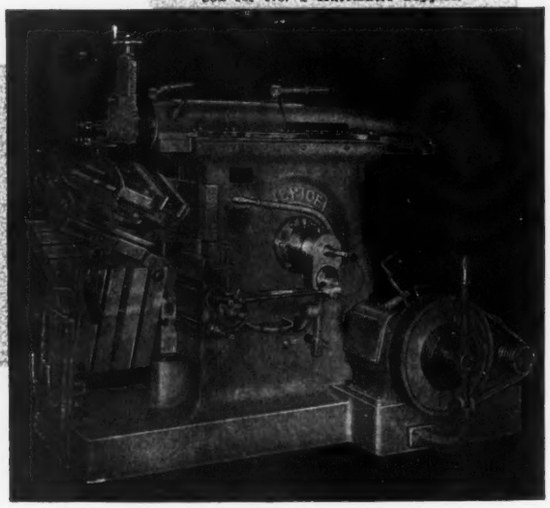


Garvin 2X Automatic Tapper—with Timken Tapered Roller Bearings, accurate clutch adjustment, positive spindle alignment, hardened chrome nickel gears in selective type four-change speed box. Three-change speed box for No. 1 Automatic Tappers.



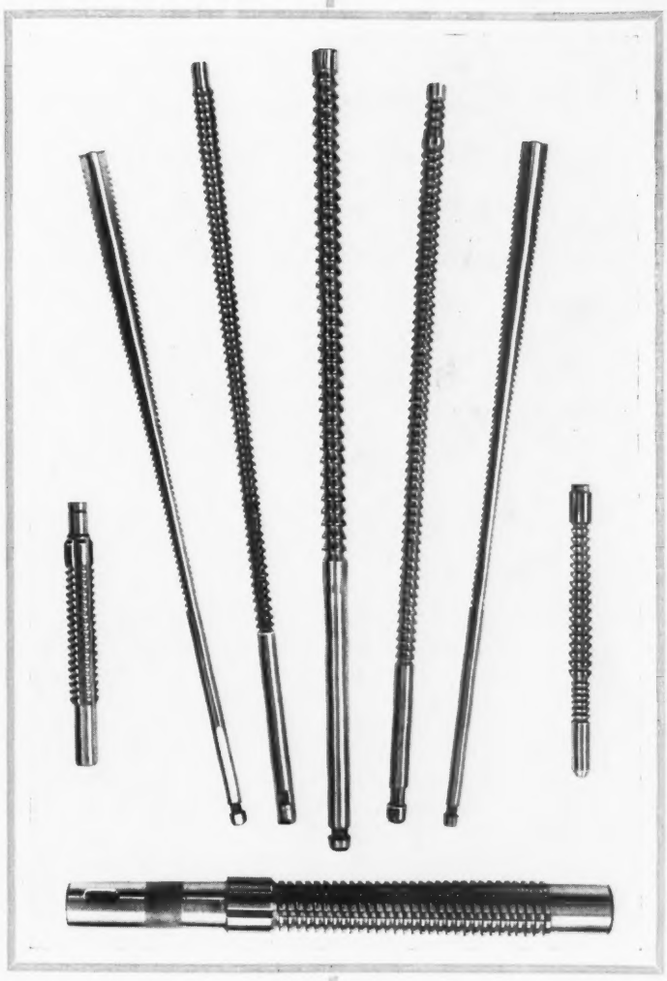
Chard Lathes—Timken Roller Bearing Equipped; 16", 18", 20", 24" and 28" sizes; multi-speed motor, single pulley drive, or belt drive.

Steptoe Shaper—Timken Tapered Roller Bearings and latest type Feed Mechanism; feed changes and ram position changes made while machine is in motion. Bronze and Felt wipers keep ways of machine clean and oiled at all times.



FAVOR

IN THE AUTOMOTIVE FIELD MUST BE EARNED



practically All automobile manufacturers use Colonial Broaches

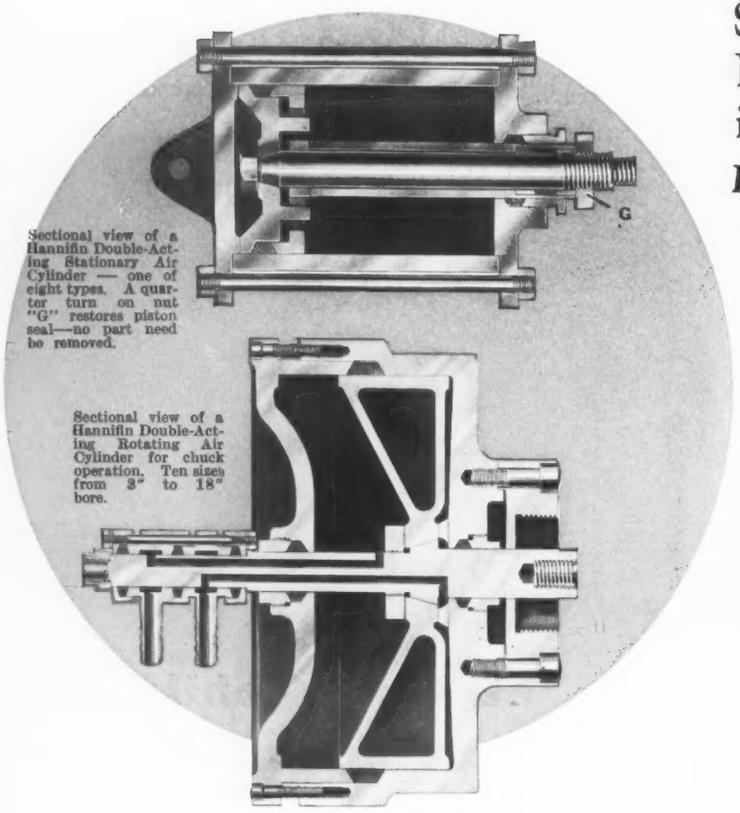
—and as there is no class of industrial producer more exacting in his standards for tools and results we can rest assured that it is Colonial Broach quality that sells these tools.

Broach users throughout the metal working industries can count on Colonial to insure broaching quality and economy in this important operation.

COLONIAL BROACHES

COLONIAL BROACH CO.
147 Jos. Campau Avenue
Detroit, Michigan

HANNIFIN AIR CYLINDERS



Sectional view of a Hannifin Double-Acting Stationary Air Cylinder — one of eight types. A quarter turn on nut "G" restores piston seal—no part need be removed.

Sectional view of a Hannifin Double-Acting Rotating Air Cylinder for chuck operation. Ten sizes from 3" to 18" bore.

Stationary and Rotating Double-Acting Cylinders in a wide range of sizes

Increase Efficiency—Lower Costs

With HANNIFIN Air Cylinders you can quickly apply flexible and rapid power at much lower cost than by any other means. Stationary Double-Acting Air Cylinders are used for applying power to arbor presses, assembling fixtures, testing devices, work holding fixtures, riveting presses, and a great variety of production tools. They are available in any desired stroke with bores of 3", 4-½", 6-½", 8", 10" and 12"—or larger, if required.

HANNIFIN Rotating Cylinders for operation of lathe chucks are backed by nearly twenty-five years of specialized experience in the design and manufacture of air operated production equipment. They are used as standard equipment by leading machine tool builders. Available in ten sizes—from 3" to 18" bore.

Complete elimination of troublesome expensive cup leathers is an outstanding feature of HANNIFIN Air Cylinders in both stationary and rotating types. In place of cup leathers a soft graphite-treated piston packing is employed. Both types of cylinders are so constructed that the piston seal can be easily and quickly adjusted from the outside without removing a single part.

It will pay you to investigate the cost reducing possibilities of HANNIFIN Air Cylinders, and other HANNIFIN Air Operated Equipment. A complete, illustrated catalog will be mailed on request.

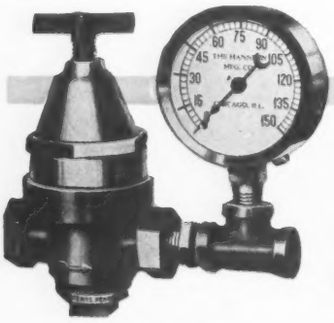
Hannifin Products—

Standard Air Operated Chuck
Special Air Operated Chucking Devices
Air Operated Clamping Devices
Air Operated Expanding Mandrels
Air Operated Presses
Air Operated Jigs and Fixtures
Rotating Double-Acting Air Cylinders
Stationary Double-Acting Air Cylinders
Air Operated Vises
Air Control Valves for all Purposes
Air Operated Riveting Presses
Air Clutch Countershafts
Pressure Regulating Valves
Adjustable Boring Bars.

HANNIFIN MANUFACTURING CO.

621 S. KOLMAR AVE., CHICAGO, ILL.

Fenwick Freres & Co., 8 Rue de Rocroy, Paris, France; Buhling and Boker, Koeniggraetzerstrasse 15, Berlin, Germany; Gotzl & Schmidt, Revolueni 13—Prague 1, Czecho-Slovakia; Coats Machine Tool Company, 14 Palmer Street, London, England; International Machinery Company, Hamilton, Canada.

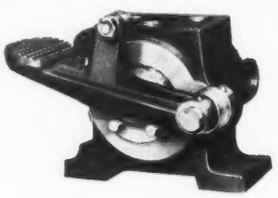


Hannifin Pressure Regulating Valve

For air or hydraulic to 200 lbs. pressure. Can be instantly adjusted to required working pressure. Positive pressure control, with unrestricted flow of air. Four sizes—⅜", ½", ¾" and 1"—with pressure gauge.

Model FS "Pack-less" Air Control Valve, Disc Type

Spring return foot model, simply and sturdily made of semi-steel in 3 sizes—¼", ½" and ¾". Elimination of packing prevents leakage and requires no maintenance.



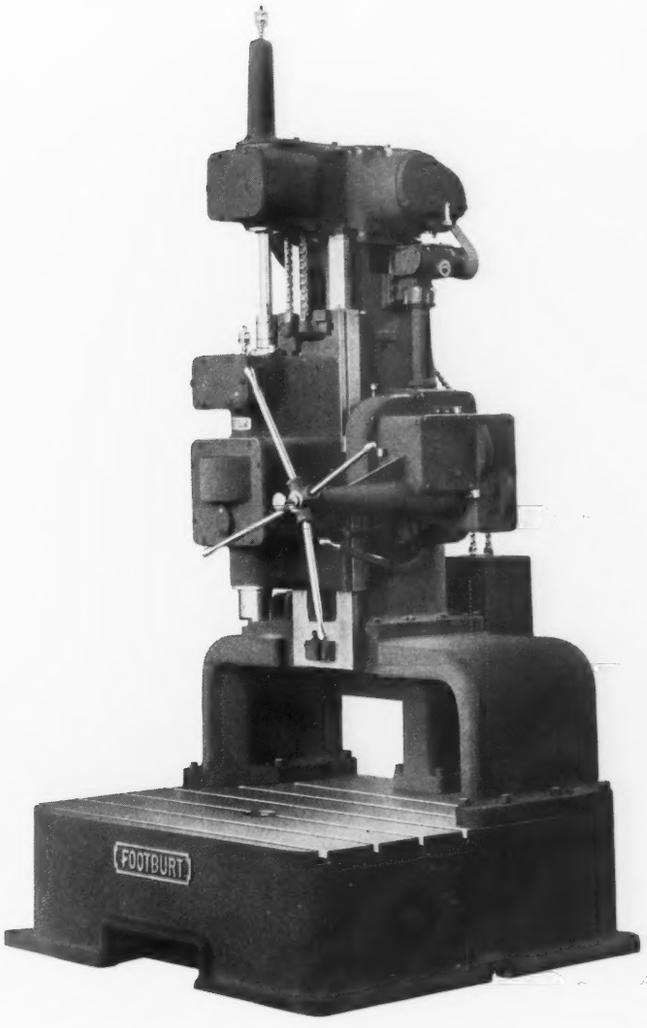
Model FR "Pack-less" Air Control Valve, Rotary Disc Type

For heavy duty foot control of Arbor and Riveting Presses —large non-rotating cylinders. One size ¾"—with choice of reducing bushings.

Model V or P "Pack-less" Air Control Valve, Disc Type

Hand control model made in 3 sizes—¼", ½", and ¾"; fine steel and bronze construction throughout. Model V is for chuck operation—model P for arbor presses and stationary cylinders.

FOOTBURT



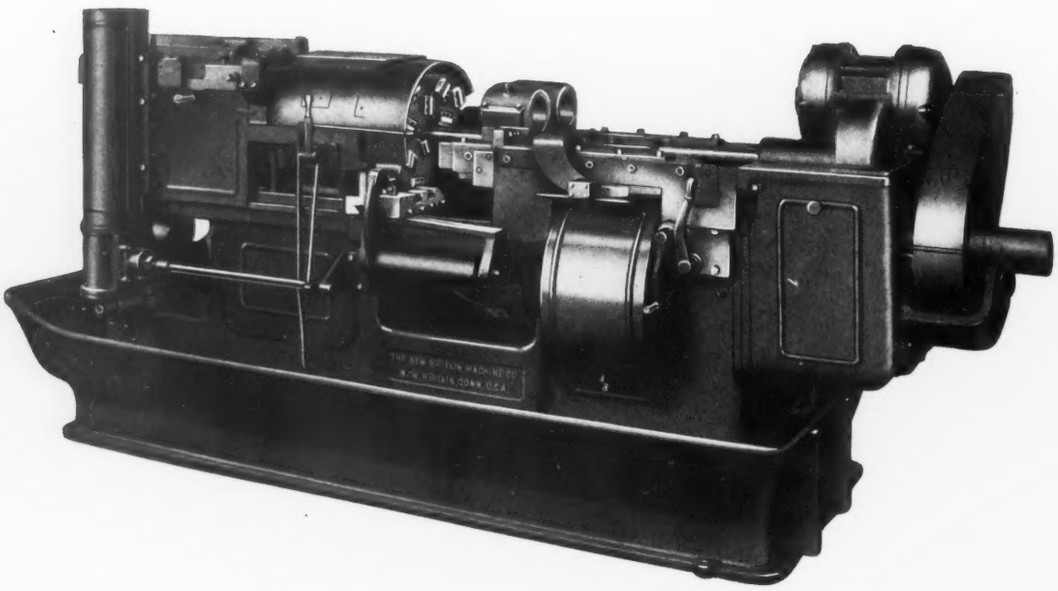
Have you a boring problem?

This machine has answered in an economical way, the problem of boring hubs of agricultural implement wheels. Sizes ran up to 3" bore 10" long with 4" counter-bore 1" deep. It is just one of many special applications of our No. 15½ line.

May we figure with you on your drilling, boring, reaming and tapping problems? Just write.

THE FOOTE-BURT COMPANY
CLEVELAND, OHIO
Detroit Office, 4-151 General Motors Bldg.

PIONEERS IN BETTER DRILLING METHODS



NewMatic Chucking Machines

An important feature of the NewMatic line of chucking machines is ease of operation through automatic mechanism, eliminating operator fatigue and allowing two or more machines to be tended by one man.

Four and six rotating work chucks with a corresponding number of end tool positions and three or four cross slide positions permit machining time to be lowered to minimum.

Maximum productions thus obtained from NewMatic machines at lowest possible labor cost.

NewMatics are available in four sizes, No. 454 four spindle — 8 inch chucks: No. 654 six spindle — 6⅝ inch chucks: No. 452 four spindle — 6 inch chucks: No. 652 six spindle — 4⅜ inch chucks. Machine illustrated is No. 454.

THE NEW BRITAIN-GRIDLEY MACHINE CO.

NEW BRITAIN, CONN.

U. S. A.

NOW= STANDARDIZING ON COLONIAL No. 7

The punch and die are illustrated at the top. The punchings to the left indicate the toughness of this job.

Over 50,000 holes were punched through ½" angles at the time the above photo was made. The users expect to duplicate that run before regrinding the dies.

More manufacturers are realizing that it pays to standardize on a tool steel that continues to give uniformly good results.

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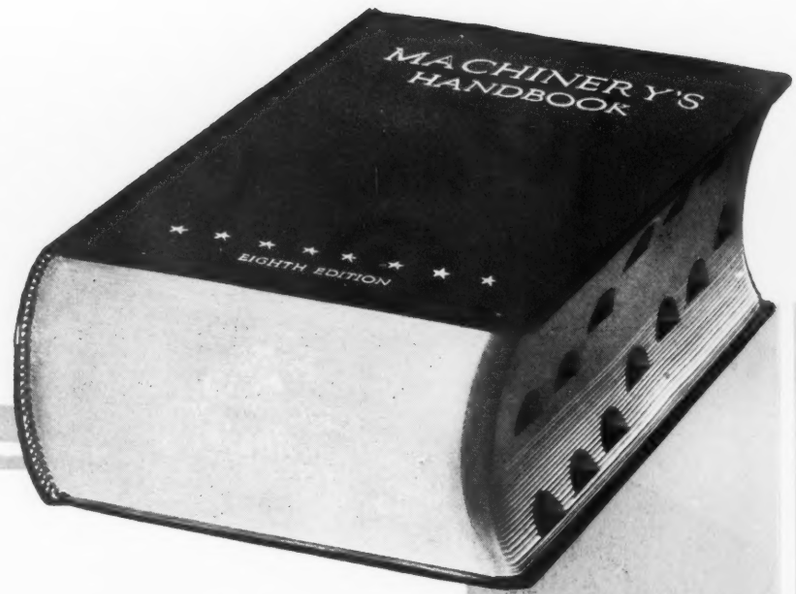

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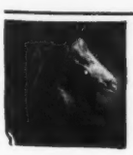

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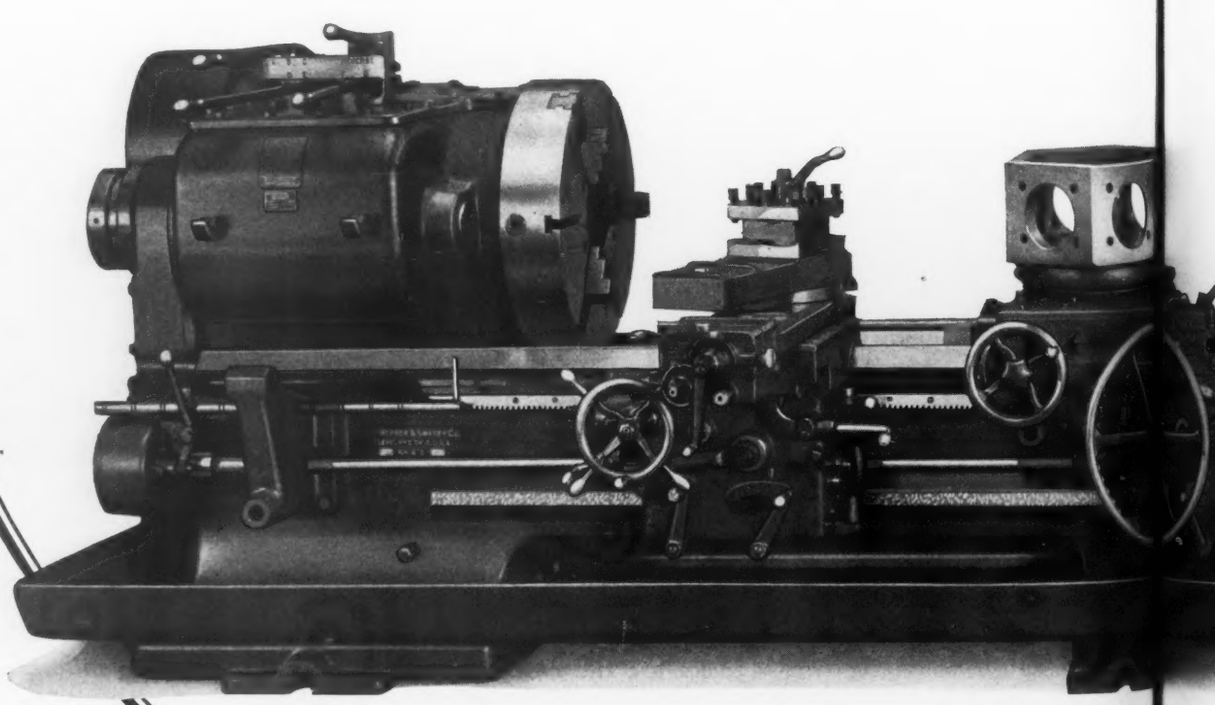

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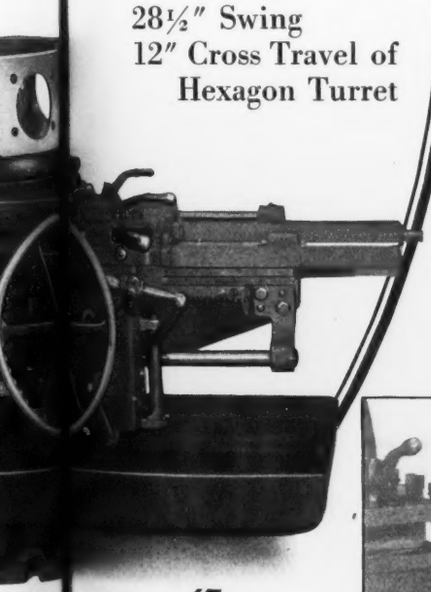
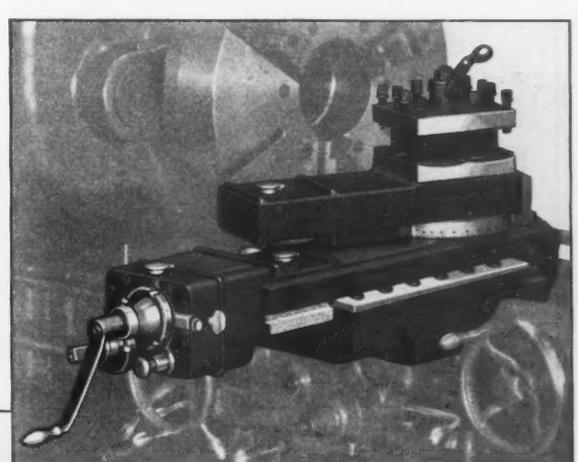
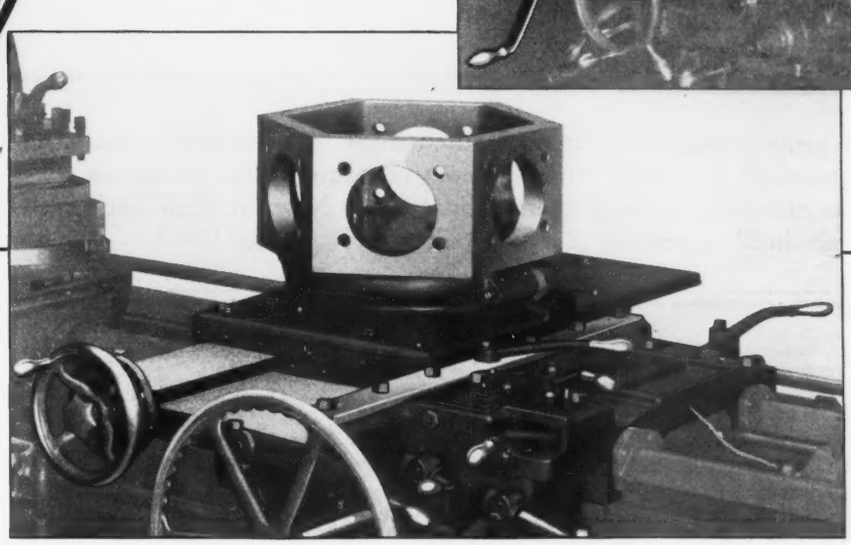


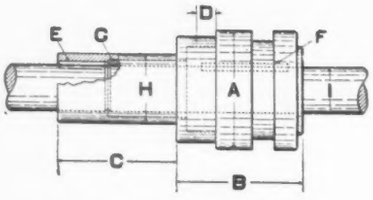




THE JOHNSON FRICTION CLUTCH

USE THE

JOHNSON FRICTION CLUTCH



Single Cut-off Coupling Clutch

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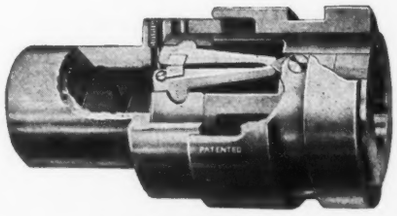
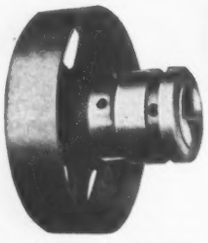
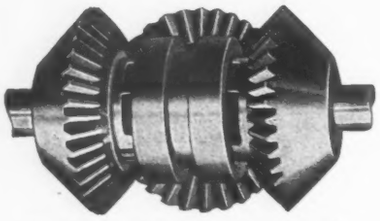


Single Clutch—Sectioned

FARM IMPLEMENT MACHINERY



Single Clutch with Pulley



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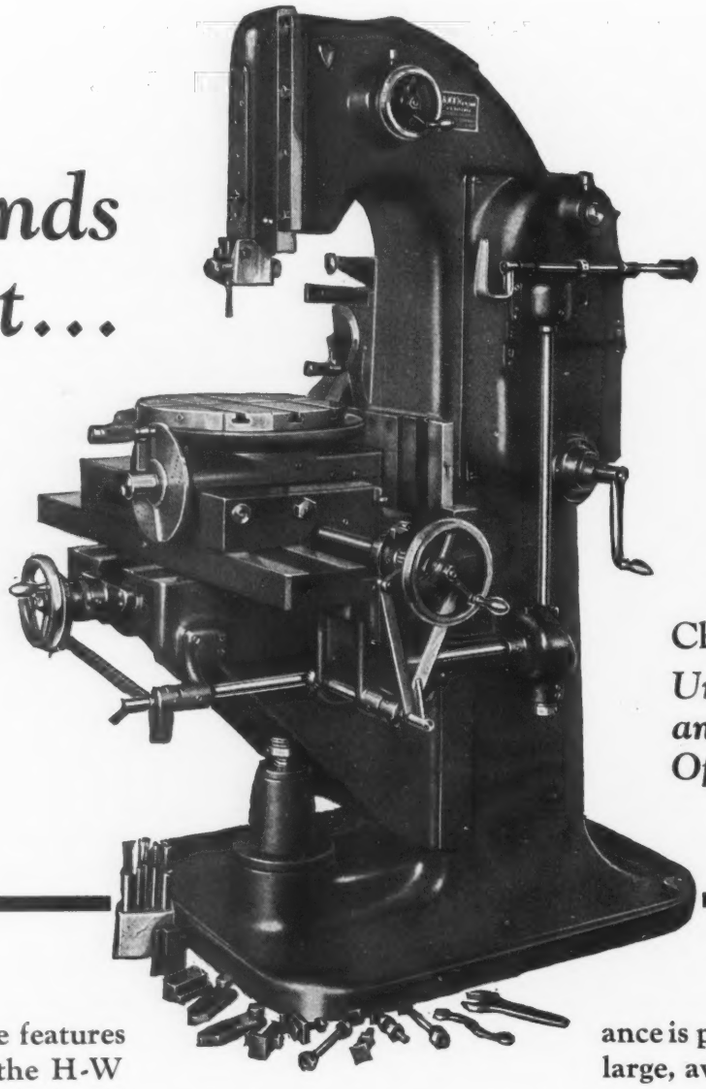

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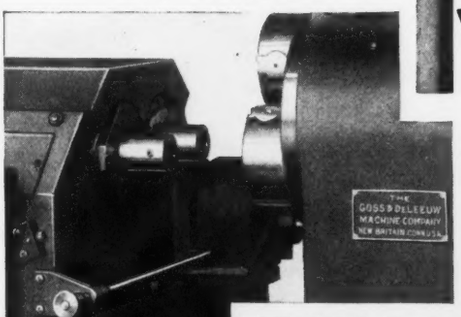
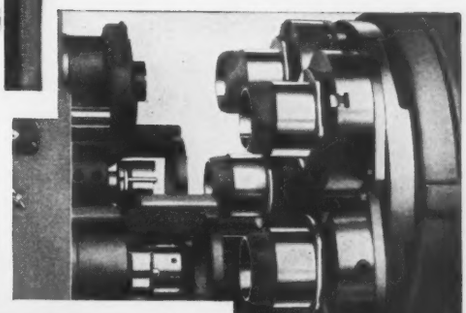
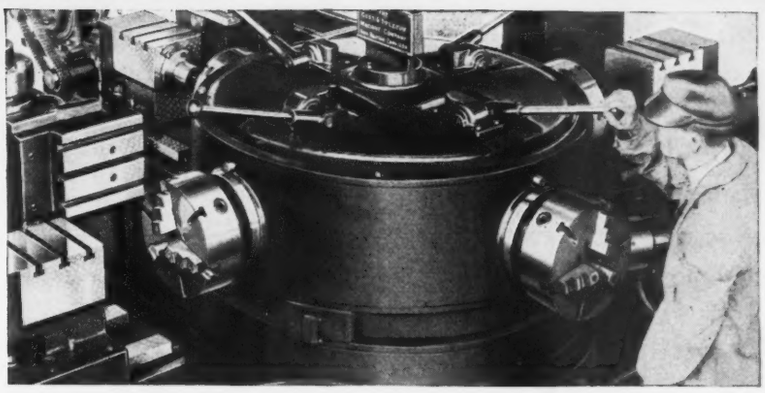


TOOL ROTATING AND WORK ROTATING TYPES

4 & 5 SPINDLE



QUAD-RADIAL
WORK ROTATING



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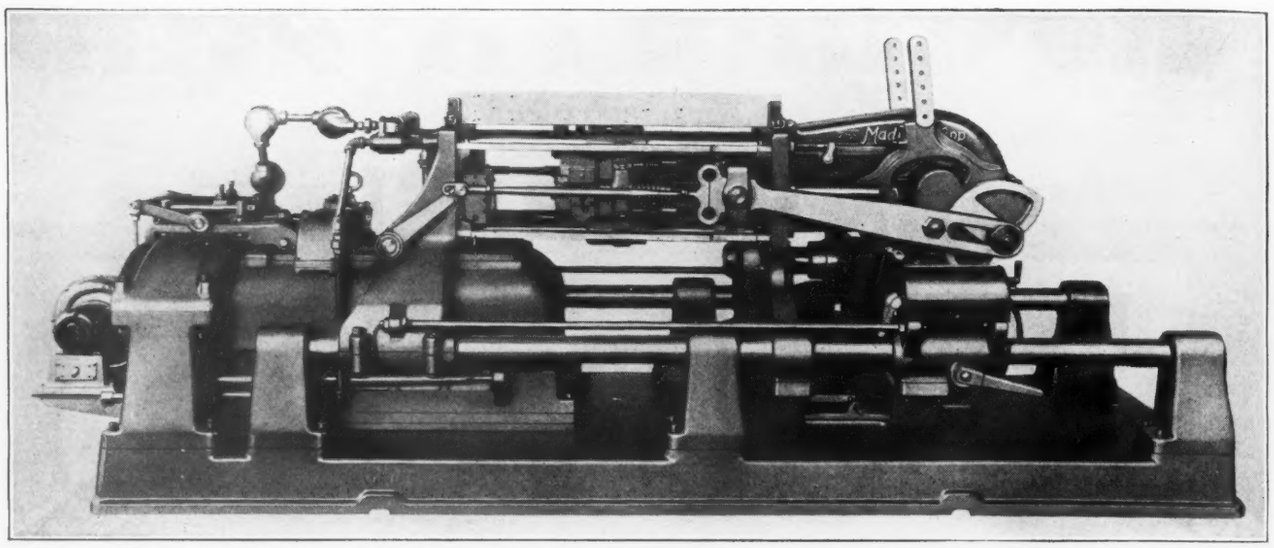
Kippcasting



This is the No. 4—size 12″x16″—Weight, 14,000 lbs.—Length, 13′—Width, 51″—Height, 52½″. There is also a smaller machine No. D.C.—size 10″x14″.

has greatly extended the field of economical use for die cast parts

During the past year, Kippcasting has greatly extended the field for use of die cast parts. Particularly notable has been the development of automatic dies for the accurate casting of larger parts, and more intricate parts.

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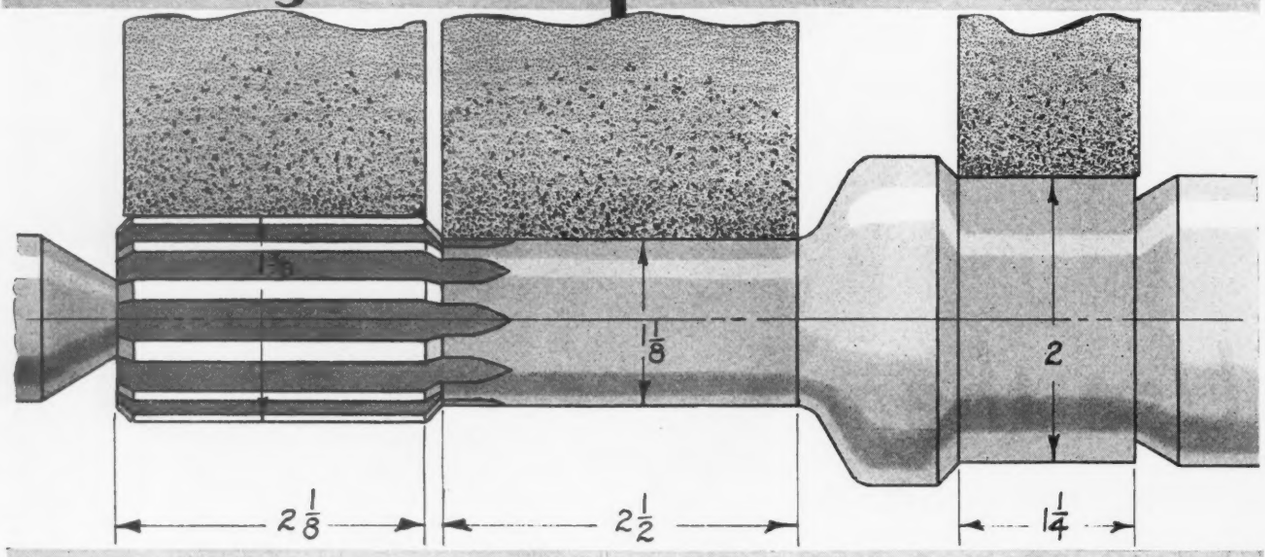

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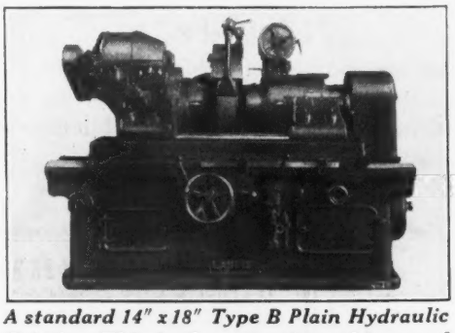
Many parts lend themselves to it. Of the numerous records in our files we have chosen the stub shaft, shown above, as an ideal example. Three grinding wheels, each approximately 30″ in diameter, working simultaneously are turning out stub shafts at a rate of 180 per hour. .015″ to .020″ stock is removed. One hundred pieces are ground between wheel dressings. For short periods of time as many as five pieces have been ground per minute.

It is of the utmost importance for you to remember that each of these pieces is handled but once. And furthermore by employing this method of grinding, each diameter is concentric with each other diameter without pressing into use a large amount of special complicated equipment.



A standard 14″ x 18″ Type B Plain Hydraulic Grinder. This is the type of machine used for such jobs as the one here described.

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WAYNESBORO PENNSYLVANIA
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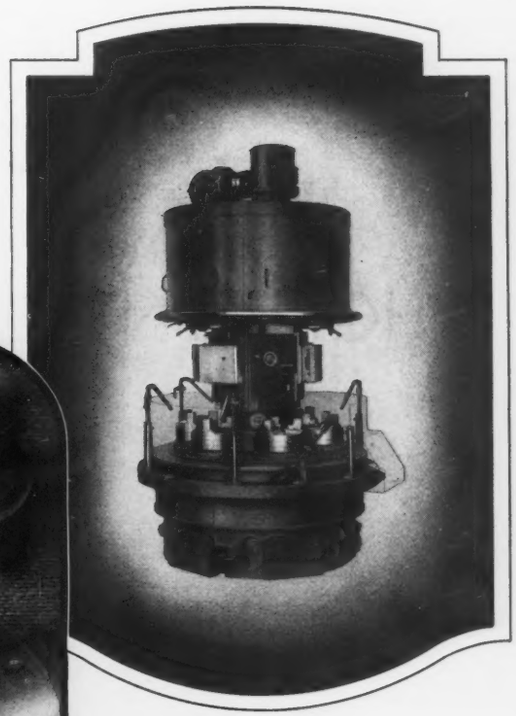

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Thus, "The Method" provides maximum earning capacity at substantially lower production cost.

Details submitted upon request.

The Bullard Co.

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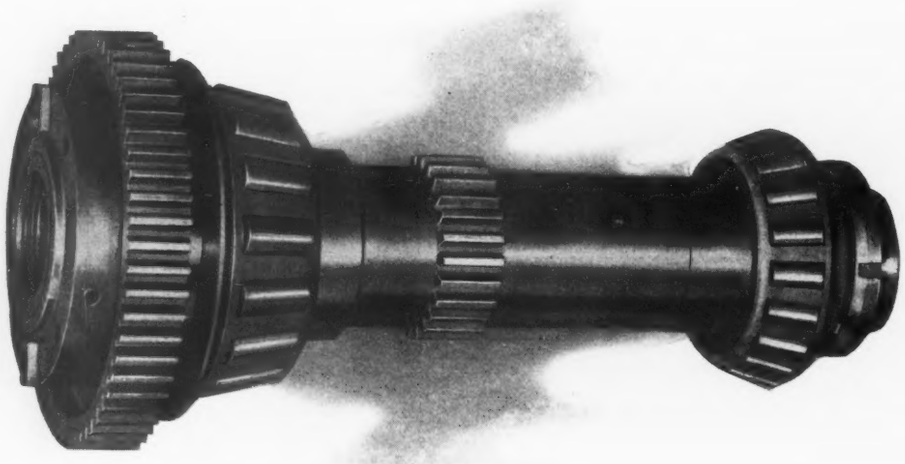
SPINDLE SPEEDS

What Spindle Speed do you want in a HORIZONTAL BORING MACHINE?



The No. 30 Tri-Way with 3" spindle is regularly built with spindle speeds up to 650 revolutions per minute. At 650 R. P. M. a 3/8" twist drill or end mill has a surface speed of 63 ft. per minute. How often do you use tools as small as these on a horizontal boring machine?

However, one of our customers machining aluminum parts has for more than a year been running one of our boring machines at 812 R. P. M. without having to "take up" the spindle bearings.

In cases where very high speed is needed, we do not hesitate to recommend a spindle speed for the spindle of our No. 30 Tri-Way of 900 R. P. M. This is possible because of our unique antifriction spindle bearing construction together with the best engineering practice throughout the entire machine.

UNIVERSAL BORING MACHINE COMPANY

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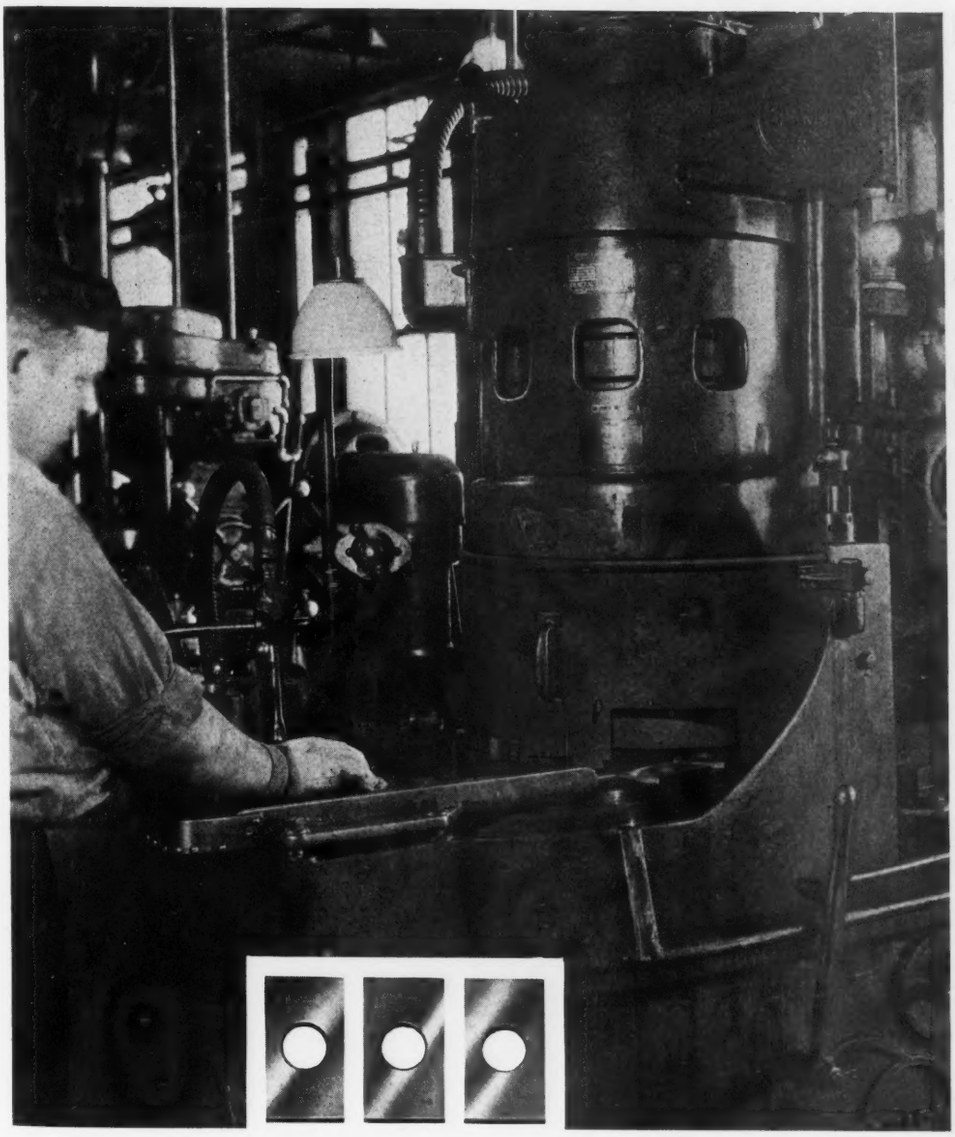

No. 16-A AUTOMATIC SURFACE GRINDER

THIS machine gives remarkable production with uniform accuracy on work within its range. The operations of chucking, grinding, measuring, unloading, demagnetizing and cleaning the chuck, are all performed entirely by the machine.

The piece being ground is a yoke plate used in a dynamic loud speaker.

Material: Cold Rolled Steel
Size: 3/8" x 3" x 5 5/16"
Stock Removed: .010 to .015
Limits: ± .0025
Production: 500 pieces per hour

Send blueprints or samples of your work for conservative time estimates.

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ACCURACY—SPEED—ADAPTABILITY—FIXTURE SAVING—OPERATION SAVING—MATERIAL SAVING

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A Corrosion Resistant Steel for the Widest Range of Applications . . . . .

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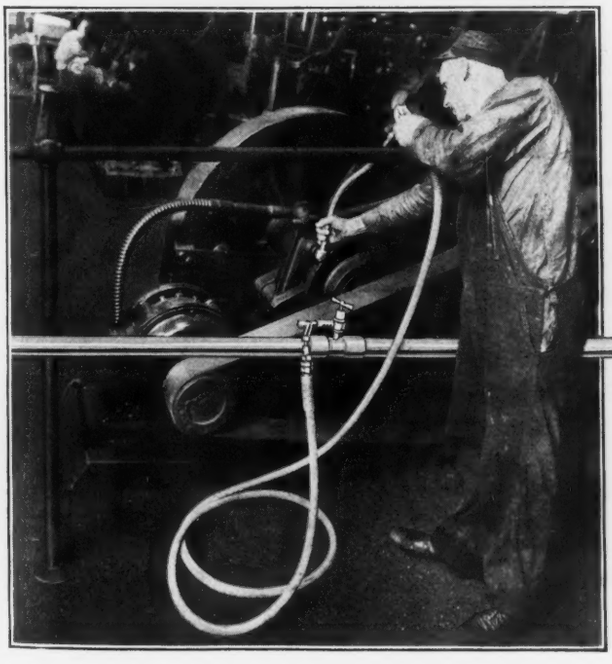
(Above) The Alemite PA 400 Compressor; capacity 410 lbs.

(Below) Safe and clean—with individual lubrication and inspection for every bearing.



There Is No Longer Any Need To Carry It Around!

HERE is the new Alemite development that makes lubrication amazingly simple and absolutely *sure!* Just fill the Alemite High Pressure Master Pump with an entire barrel of fresh lubricant. Then, when the power is turned on, the lubricant is immediately available under high pressure *anywhere* in your plant that you may care to pipe it.

Outlets can be conveniently located. Your operator can instantly attach a 20-foot flexible high pressure hose to any outlet—enabling him to lubricate every bearing within the radius of a 40-foot circle by simply attaching the hose coupling to the Alemite fitting on the bearing.

By operating the release valve in the high pressure hose line the operator can give every bearing *individual* attention and completely control the amount of lubricant put into each bearing.

Thus, lubricant reaches the bearings as clean and fresh as the day it left the refinery—and it is conveyed to the point where you need it in the same practical manner that steam and water are now piped throughout your plant.

This Alemite High Pressure Master Pump is but one of 7000 lubrication appliances which Alemite designs and builds for industrial use. Today, more than 12,000 leading manufacturers use these Alemite appliances for lubrication of their machinery—and practically all leading machinery manufacturers now furnish Alemite fittings as standard equipment.

Industrial lubrication service and information are available to you through all of Alemite's 49 offices, where Alemite Lubrication Experts are stationed. Without obligating yourself in any way, mail the coupon today for full details of the specialized lubrication service Alemite offers to modernize lubrication in *your* plant.

ALEMITE

ALEMITE CORPORATION 471
(Division of Stewart-Warner)
2678 N. Crawford Ave., Chicago
Please send your representative to our office (or send complete details of your plan)

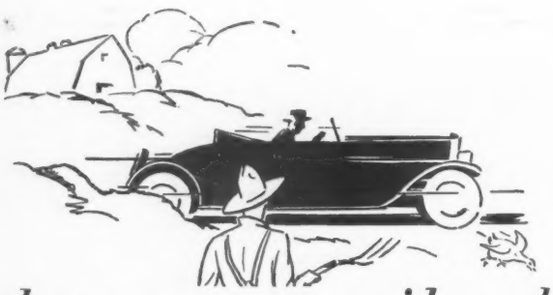
Name.....

Title.....

Firm Name.....

Address.....

City..... *State*.....

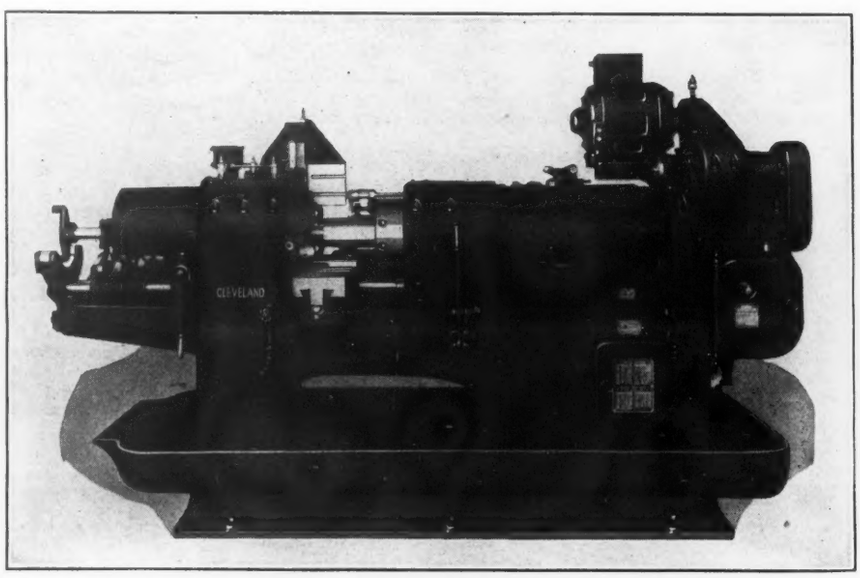


When you "DO SIXTY," *how many miles do you* AVERAGE?

PERHAPS 35 to 40 in a day's run, when the stops and incidental delays have eaten into your total. In machine shop practice, too, it is the net speed at the end of the day's run that counts for economy and ability to stay in business.

¶ With outstanding speed per minute, the latest Cleveland Automatics combine a dependability, precision and convenience which bring their actual daily and monthly performance close to their theoretical speed.

¶ Minimum attendance, minimum wastage, time-saving co-ordination and ability to stand up under long hard runs...these are the qualities that show in the profit sheets of Cleveland Automatic users. Let our engineers assist in cutting your own production costs.



Newest Cleveland Automatic Model M 4-Spindle Bar Machine, equipped with square turret attachment.

CLEVELAND AUTOMATICS

THE CLEVELAND AUTOMATIC MACHINE COMPANY

2269 Ashland Road, Cleveland, Ohio, U. S. A.

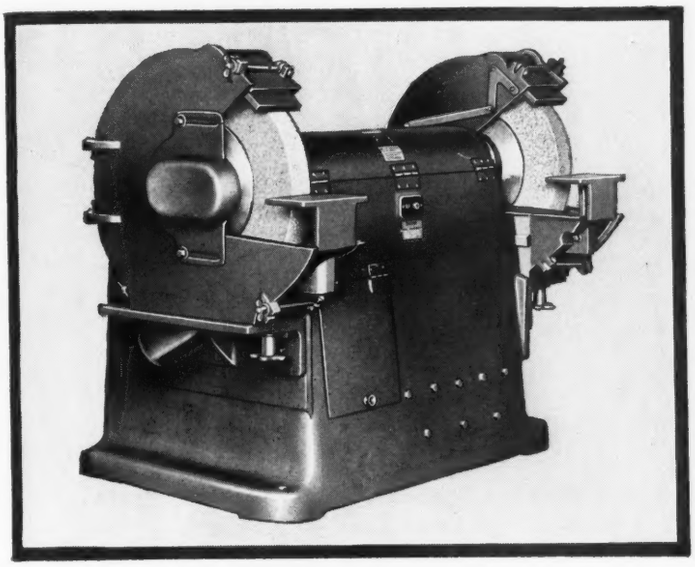
NEW YORK *95 Liberty Street*

CHICAGO *565 W. Washington Boulevard*

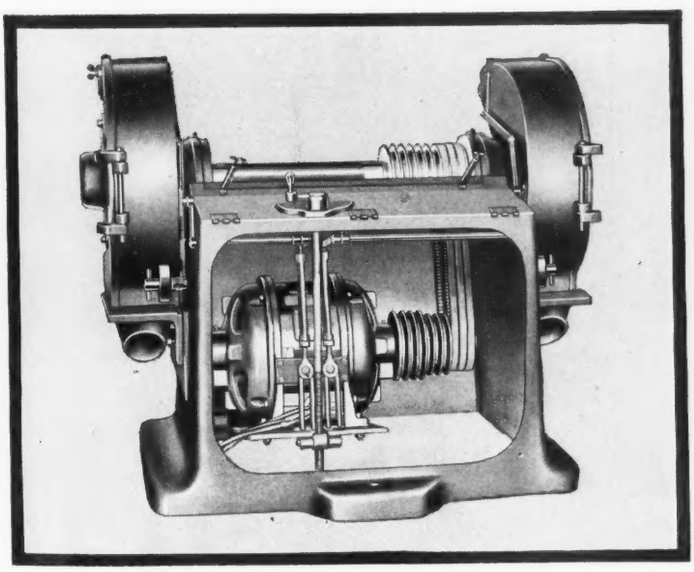
DETROIT *1217 Book Building*

BLACK & DECKER-VAN DORN
SUPER PRODUCTION TOOLS

New 24″ and 30″ A. C. Grinders Added to Black & Decker-Van Dorn Line



Ideal for foundries, forge shops and all heavy grinding work, the new 24″ and 30″ A. C. Grinders are built to maintain their power and speed under peak loads.



Photograph shows the internal mechanism of one of the new A. C. Grinders. Note the three sets of pulleys which make it easy, by a simple adjustment of the "V" belts, to increase the spindle speed to compensate for wheel wear.

Three-speed adjustment keeps cutting speed approximately constant throughout the life of the grinding wheels

FOUNDRIES, forge shops, all industries that have heavy grinding operations, will welcome the new Black & Decker 24″ and 30″ Multiple Speed A. C. Grinders. Available for any standard A. C. current, and built to maintain a high degree of efficiency under the extreme loads, they will speed up the heaviest grinding jobs.

The tool rests are an integral part of the wheel guards, so that the guards automatically assume the safest working position when the operator adjusts the tool rests to compensate for wheel wear. Also, as the tool rests are adjusted, the operator is compelled to make the quick, simple spindle speed adjustment which keeps cutting speed approximately constant.

The 24″ Grinders are available in 10 or 15 H. P., with a primary wheel speed of 6000 S. F. P. M., or in 15, 20 or 25 H. P. with a primary wheel speed of 9000 S. F. P. M. The 30″ Grinders are available in 20 or 25 H. P. with a primary wheel speed of 9000 S. F. P. M.

Mail the coupon for further details of these A. C. Grinders, and for a catalog showing all models of Black & Decker-Van Dorn Heavy Duty Grinders and Buffers. Black & Decker-Van Dorn, Towson, Md., U. S. A.; Toronto, Ontario, Canada; Slough, Bucks., England; Sydney, Australia.

BLACK & DECKER-VAN DORN
Super Production Tools

BLACK & DECKER-VAN DORN
Towson, Md., U. S. A. MY

☐ Please send me full information about the new 24″ and 30″ A. C. Grinders.

☐ Also your complete catalog of Heavy Duty Grinders and Buffers.

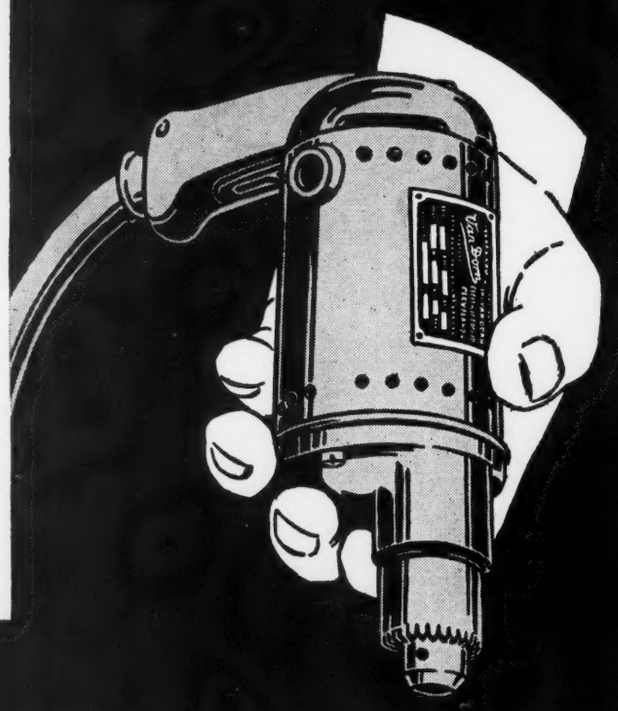
*Name*_____

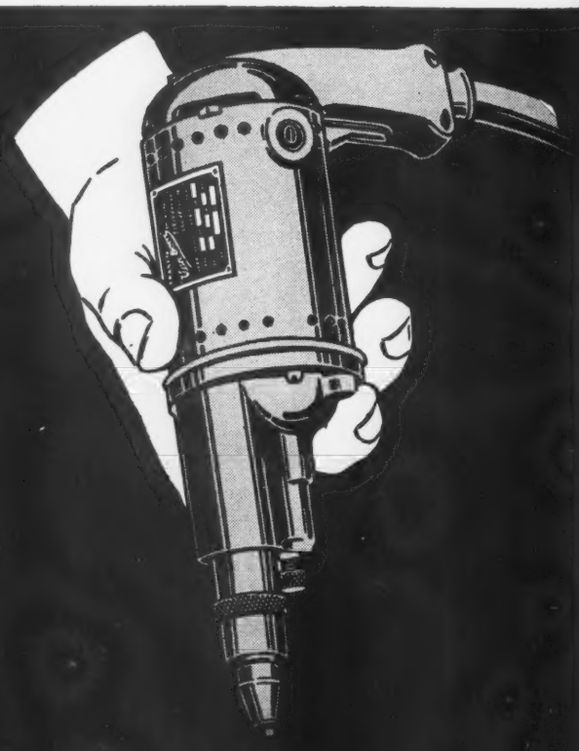
*Street Address*_____

*City*_____ *State*_____

The New "Van Dorn" UNIVERSAL TWINS

for fast work
in Close Quarters





No. 1 Adjustable Clutch Electric Screw Driver.
Net weight 4¼ lbs. **$48.00**

3/16" Ball Bearing Electric Drill.
Net weight 3 ¾lb. **$36.00**

THESE Universal Twins are real production tools—ruggedly constructed, light in weight, powerful in operation, easy to handle. They are designed for doing tedious jobs quickly and working in close quarters. The diameter of the body is small, and exterior surfaces are rounded to afford the operator easy grasp at any part.

The screw driver is equipped with an adjustable friction clutch which drives the screw "flush" and releases immediately without danger of marring the screw head or the surrounding surface. This clutch can be conveniently set to any desired tension by means of the knurled thumb screw on the gear case. When necessary, bit can be given an additional turn by pressing with finger on adjusting thumb screw which momentarily increases tension on friction clutch. Clutch can be adjusted for driving various types and sizes of small screws and to compensate for the different conditions in driving into wood or metal. In addition, this screw driver has the positive clutch which allows the spindle to remain idle for finding slot in screw. This positive clutch engages the bit when pressure is exerted.

The drill is fitted with a three-jaw geared chuck of 3/16" capacity and has all the features found in Van Dorn Electric Drills of larger size. Each tool has a Universal Motor with ball bearings on the armature shaft, and also on the spindle, and is equipped with a 3-conductor cable and attachment plug. Furnished for 110, 220 or 250 volts.

Mail the coupon below for further information about the Van Dorn Universal Twins, and for the complete catalog of Van Dorn Portable Electric Tools.

Order from your Jobber

MAIL TODAY FOR INTERESTING DETAILS

The VAN DORN ELECTRIC TOOL CO. MY
Towson, Maryland, U. S. A.

☐ Please send full information about the new Van Dorn Universal Twins.

☐ Also send the new Catalog showing the complete line of Van Dorn Portable Electric Tools.

*Name*_____

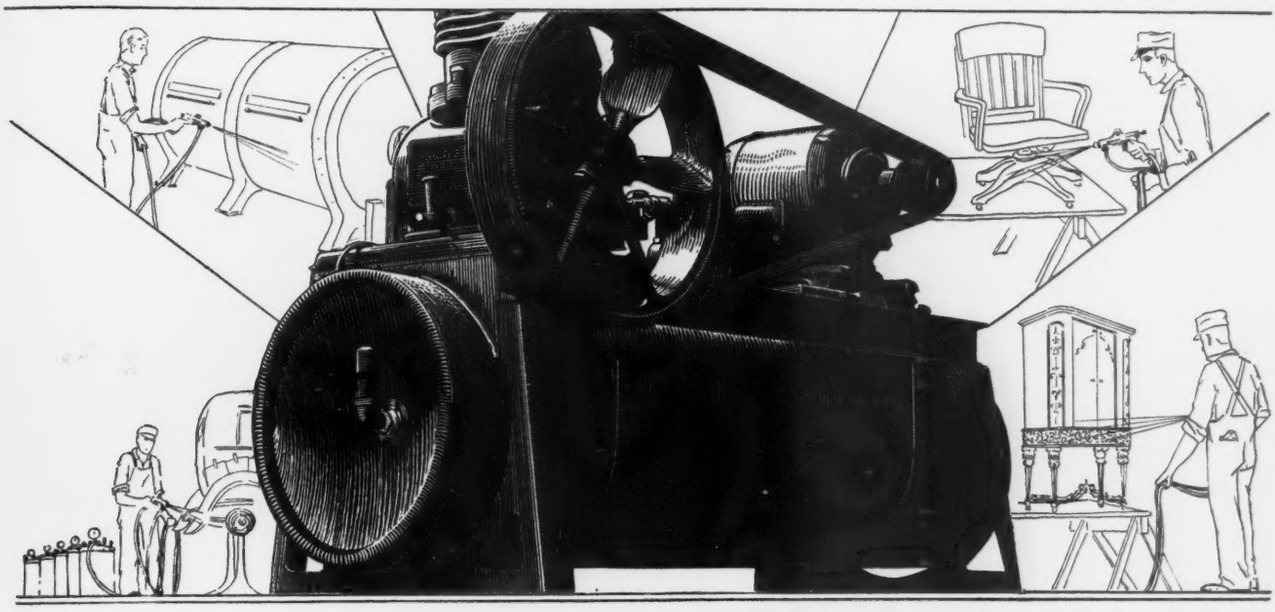
*Address*_____

*Jobber's Name*_____

For power
specify "Van Dorn"

The VAN DORN ELECTRIC TOOL CO.
TOWSON, MARYLAND, U. S. A.

A WORLD'S STANDARD OF DEPENDABILITY



INCREASED SALEABILITY —NET PROFITS—WITH BRUNNER AIR

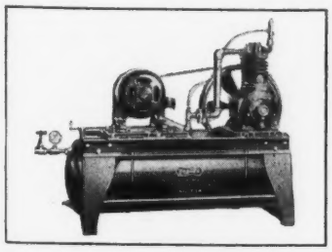
SPRAY GUN MODEL 300
Light weight, well balanced, adjustable to fan or round spray. Efficient for high speed work or touch-up jobs.

CORRECTLY painted products mean better appearance, more protection, increased saleability, added net profits. Metal product manufacturers seeking a means of increasing sales without boosting production costs are turning to Brunner Spray Paint Equipment.

Brunner equipment is built on a basis of exhaustive research to determine the best methods of painting metal products, equipment and parts. It includes many exclusive features—spray guns that handle with equal effectiveness nearly every kind of finishing material, lacquer, enamel, synthetic resin compounds, varnish, mill white, red lead, asphalt and prepared paints; compressors that deliver an unfailing flow of air at constant pressures; air conditioners that mean freedom from oil and moisture; pressure feed containers that facilitate the use of multiple colors.

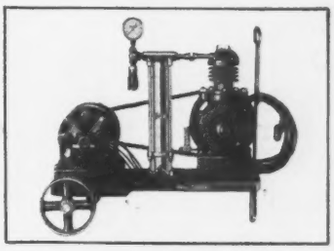
Investigate Brunner's ability to turn paint into profits thru scientific savings in time, labor and materials. The Brunner Spray Paint Catalog is prepared along instructive lines by Brunner engineers. Send for your copy today as the first step toward improving the appearance and saleability of your product in 1931.

PRESSURE FEED CONTAINER
Assures steady flow of material at desired pressures. Inner liner permits change of colors without cleaning.



SPRAY PAINTING OUTFIT No. 734
Rigid, compact and vibrationless. 1½ H. P. motor, 2 cylinder compressor.

BRUNNER MFG. CO., UTICA, N. Y.
KANSAS CITY, MO. TORONTO, CAN.



SPRAY PAINTING OUTFIT No. 700P
Light duty. Portable ⅓ H. P. motor operates off any light circuit.

BRUNNER SPRAY PAINT EQUIPMENT

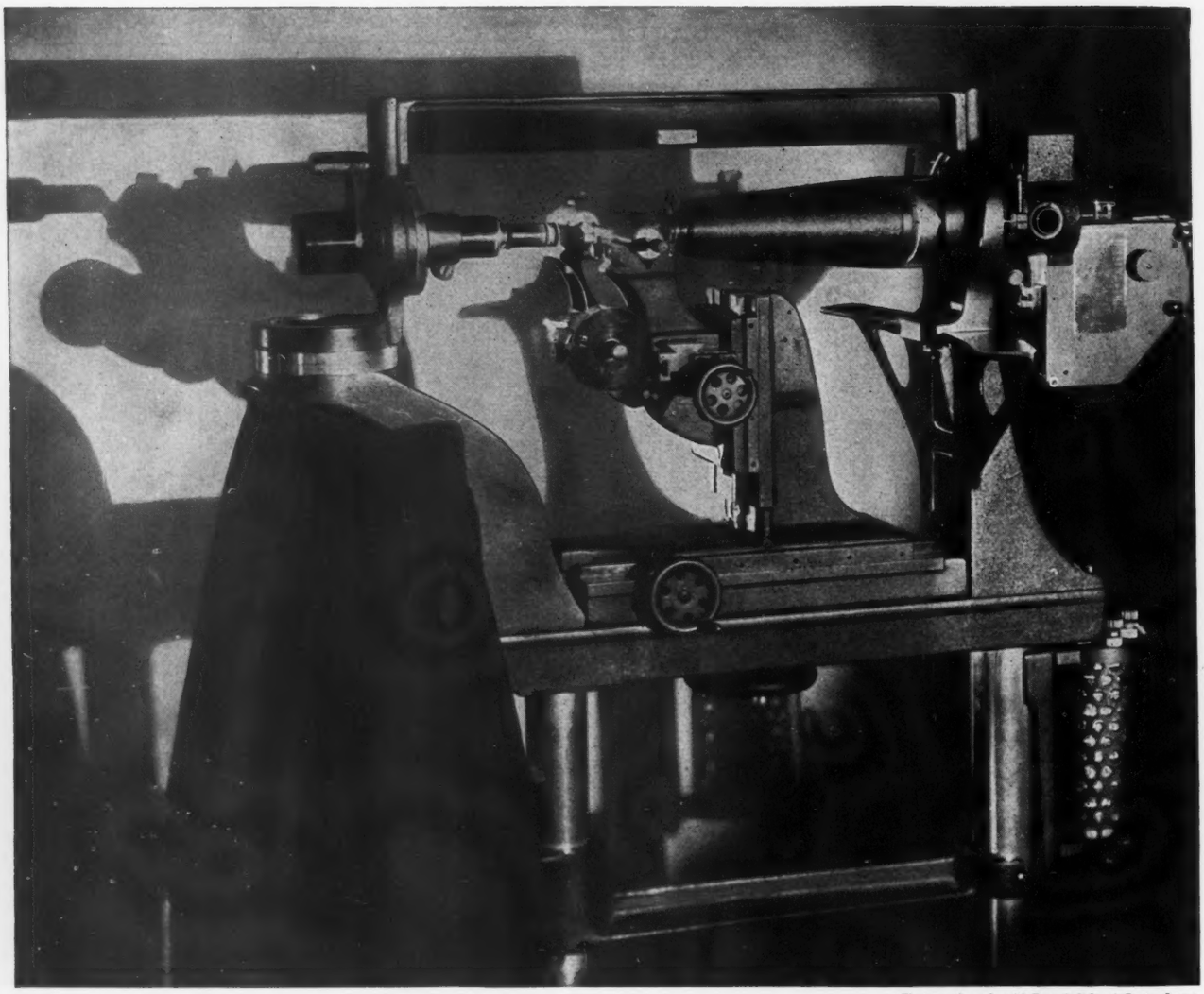
BRUNNER MFG. CO., Dept. M-6,
Utica, N. Y.

Send me the new Brunner Spray Paint Catalog.

Name_____

Firm_____

Address_____



(Photograph made with Bausch & Lomb Protar Lens)

This Age of "Visual" Measurement

IT was inevitable that industry should come to optical methods of measurement. Large numbers of commercial products are being regularly made to tolerances of .0001", and older methods of gauging and measuring are hopelessly inadequate to handle such super-accurate parts.

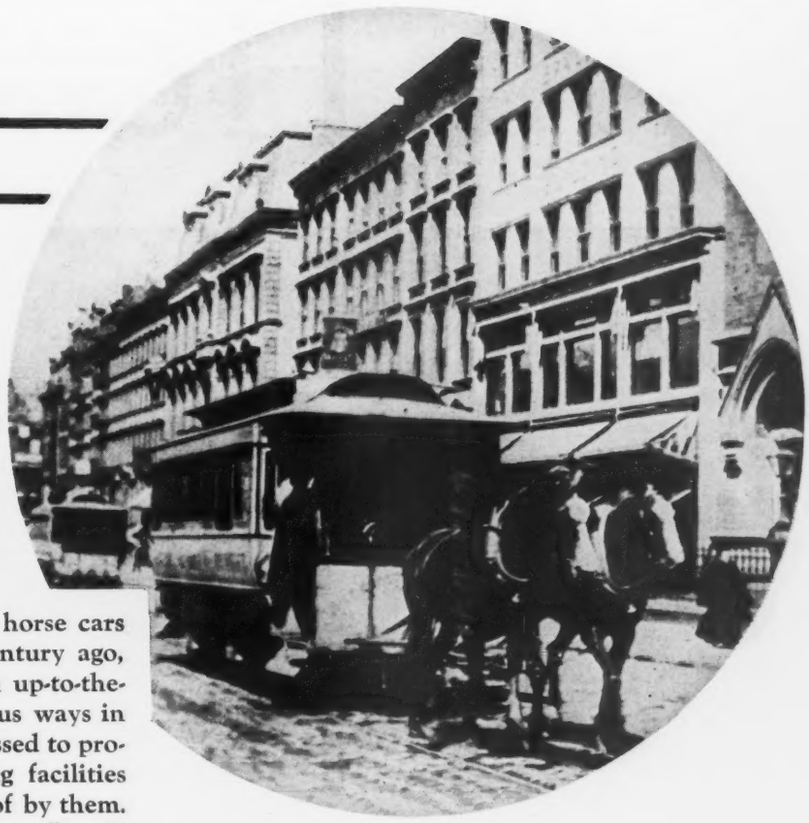
Employing the principles of a projection microscope, the B & L Contour Projector, illustrated above, throws an enlarged image — fifty to five hundred diameters — upon a screen. The contour of the article under inspection stands out in bold relief. Errors of .001" show up as large as 1/4". Operation is simple and parts may be handled quickly.

A few of the articles which can be rapidly inspected and accurately measured on the Contour Measuring Projector are:

Screw Threads, Thread Plug Gauges, Thread Ring Gauges, Taps, Dies, Spiral Gears, Shapers, Hobs, Gear Cutters, Contour Work, Profile Gauges, Small Form Work of many kinds.

Write for complete information. BAUSCH & LOMB OPTICAL CO., 619 St. Paul Street, Rochester, N.Y.

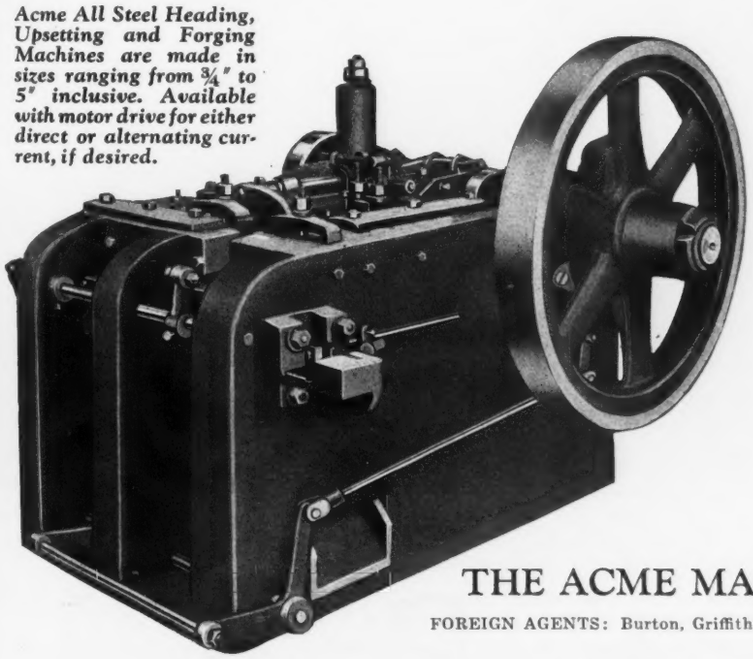
BAUSCH & LOMB



The Good Old Days

The people who rode in dinky little horse cars through gas-lit streets, a quarter century ago, thought they were well supplied with up-to-the-minute conveniences. The marvelous ways in which electricity has since been harnessed to provide luxurious transportation, lighting facilities and entertainment were undreamed of by them. But they were perfectly satisfied in those "good" old days. The street cars, hansom cabs and one-cylinder automobiles that served our mothers and fathers have become obsolete *only by comparison.* What a difference a few years make!

Acme All Steel Heading, Upsetting and Forging Machines are made in sizes ranging from ¾" to 5" inclusive. Available with motor drive for either direct or alternating current, if desired.



Some of the old Acme Forging Machines, installed during the horse car era, are still in active service. But, naturally, they're no match for the exacting standards of today's shop. They, too, have become obsolete by comparison, and should be replaced with modern equipment. The latest type Acmes are modern in every respect—thoroughly in tune with present-day production requirements. The faults so common in older machines—enlarged shanks, eccentric upsets and excessive flash—have been entirely eliminated. The speed and accuracy of the new Acmes are sensational, assuring a large, high-grade output at minimum cost. Investigate these money makers. Write today for full data!

THE ACME MACHINERY CO., Cleveland, O.

FOREIGN AGENTS: Burton, Griffiths & Co., Ltd., London. Glaenzer & Perreaud, Paris, France.

ACME FORGING MACHINES

. . . Here it is!

GENERAL

GENERAL ELECTRIC COMPANY, SCHENECTADY, NEW YORK

The New G-E Arc Welder

Combines and excels all the best features of all the good welders now on the market . . . plus new features all its own

HE HAD seemed to be demanding the impossible — the G-E sales executive — when, three years ago, he told the council of welding-design engineers to build an arc welder better than any set on the market — better in *every desirable characteristic.*

But here it is! They did the seemingly impossible! For three years, this revolutionary design of set was in the making.

For three years these specialists in arc-welding design worked closely with motor specialists, control specialists, generator specialists — in brief, with specialists in every single vital part of an arc-welding machine — in order that each part might contribute to an arc welder that would combine the best features of all the good sets on the market plus new features never before available.

HERE ARE THE FEATURES

Stable, flexible arc
Quick recovery ("pep")
Self-excitation
Spark-free commutation
Simple operation
Duplex voltage control
Dead-front control panel
Large, protected instruments
Light, compact, strong construction
Low center of gravity
A definite purpose for every ounce of material

General Electric, in placing its monogram on this remarkable set and in offering it to industry, is firmly convinced by test after test of the most exacting nature that this welder represents the biggest single step forward in the perfecting of welding equipment, that has been announced in the last decade.

Tested sets ready for prompt shipment are stocked to meet your immediate demands in 20 G-E warehouses throughout the country. Ask your nearest G-E office, to-day, for complete details and for a copy of publication GEA-1440.

JOIN US IN THE GENERAL ELECTRIC PROGRAM, BROADCAST EVERY SATURDAY EVENING ON A NATION-WIDE N.B.C. NETWORK

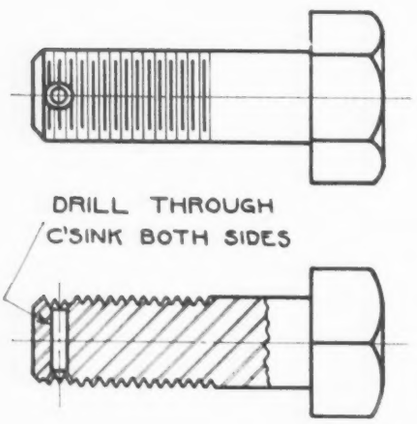
530-103

ELECTRIC

SALES AND ENGINEERING SERVICE IN PRINCIPAL CITIES

The KINGSBURY Method

Profitable Production on a Fool-Proof Machine



This Kingsbury set-up is designed for drilling and double countersinking cotter-pin holes in cap screws. There are two units, each consisting of an automatic indexing fixture and two automatic drill heads. The first drill head spots the hole, which spot subsequently forms the countersink on this side. The second drill head drills the hole and countersinks the bottom side. Loading is done manually and the work is automatically ejected into pans in the base of the machine.

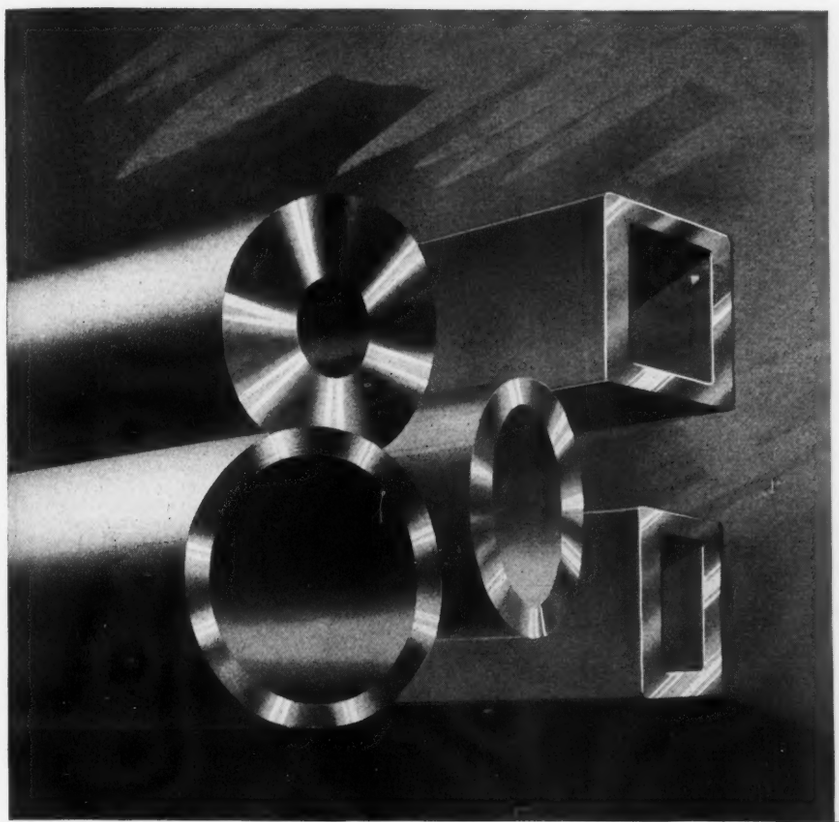
Uninterrupted profitable production is insured by the friction feed which governs the feeding of the two spindles and also controls the indexing dial.

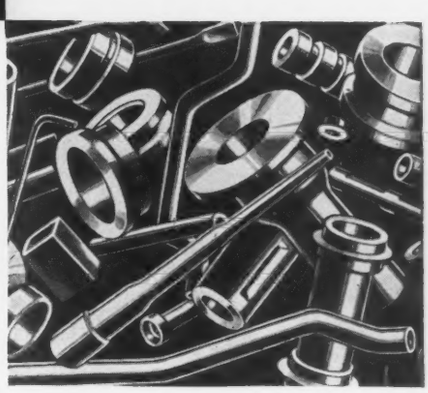
This is the fool-proof feature—if by any chance the dial jams up with chips the friction clutch slips—automatically—and the machine idles until the trouble is corrected.

This is one of a series of advertisements illustrating high production drilling and tapping by the Kingsbury Method. Send for reprints of previous advertisements. Let Kingsbury Engineers show you how to apply this modern production method to your work.

AUTOMATIC DRILLING *by the* **KINGSBURY METHOD**

KINGSBURY MACHINE TOOL CORP.
KEENE NEW HAMPSHIRE
Originators of the Automatic Drilling Head Unit





The modern way to "PARTS" MAKING

PARTS made from NATIONAL-SHELBY Seamless Tubing are of uniform sectional shape—uniform dimension—uniform physical structure and metallurgical quality—to a degree that permits exceptionally close calculations in your work.

Shapes, diameters, and wall-thicknesses can be had to suit, within a very wide range. Grades of steel and annealing procedure can be adapted to numerous mechanical requirements.

An increasing number of manufacturers are using Seamless Tubing to reduce machine work, save tools and labor, and to insure a highly uniform finished product. Perhaps you can adapt it to advantage as other manufacturers have. Send for our booklet, "Seamless Tube Standards." Or mail blue prints for specific information applicable to your needs. It will pay you to investigate the possibilities of NATIONAL-SHELBY—

America's Standard Tubing

NATIONAL TUBE COMPANY · PITTSBURGH, PA.

Subsidiary of United States Steel Corporation

US STEEL

NATIONAL-SHELBY SEAMLESS TUBING

NOW READY

New!

CATALOG "H"

The *new* BARBER-COLMAN Book of Small Tools

Our new 200-page Barber-Colman Book of Small Tools—Catalog "H"— is now ready for mailing. Because this is an entirely new edition, illustrating and describing *all* Barber-Colman Hobs, Milling Cutters and Reamers, we particularly want you to have a copy.

Partial list of contents of this new catalog

HOBS
- Ground Hobs
- Hob Sharpening Machines
- Spur and Spiral Gear Hobs
- Stub Tooth Hobs
- Spline Shaft Hobs
- Worm Gear Hobs
- High Production Hobs
- Single Position Hobs
- Square Shaft Hobs
- Sprocket Hobs
- Hobbing Machines
- Gear Information
- Spline Shaft Information

MILLING CUTTERS
- Plain Milling Cutters
- Alternate Gashed Plain Milling Cutters
- Side Milling Cutters
- Helical Mills
- Half Side Milling Cutters
- Staggered Tooth Milling Cutters
- Interlocking Side Milling Cutters
- Inserted Tooth Milling Cutters
- End Mills
- Keyseat Cutters
- Metal Slitting Saws
- Formed Milling Cutters

GEAR CUTTERS
- Involute Gear Cutters
- Stocking Cutters
- Bevel Gear Cutters

REAMERS
- Jig Boring Reamers
- Inserted Blade Shell Reamers
- Inserted Blade Chucking Reamers
- Cylinder Reamers
- Line Reamers
- Expansion Reamers
- Fluted Reamers
- Special Reamers
- Reamer Sharpening Machine

Your copy is ready. Send for it today.

To obtain this new Catalog "H", with its complete listing of all Barber-Colman Small Tools, Valuable Tables and Formulas, information on the Hobbing Process, Milling Cutters and Reamers, fill out, clip and mail the coupon below. Your copy will go forward to you by return mail.
Catalog "H" is a book you will wish to save. You will find it extremely easy to consult, and well worth consulting. Send for your copy today.

BARBER-COLMAN COMPANY
General Offices and Plant
ROCKFORD, ILLINOIS, U. S. A.

BARBER-COLMAN COMPANY M-8-31
ROCKFORD, ILLINOIS, U. S. A.

Please send me a copy of your new Catalog "H" describing Barber-Colman Hobs, Milling Cutters and Reamers.

Name_____ Firm_____
Address_____
City_____ State_____

The quickest way to true-up lathe work.

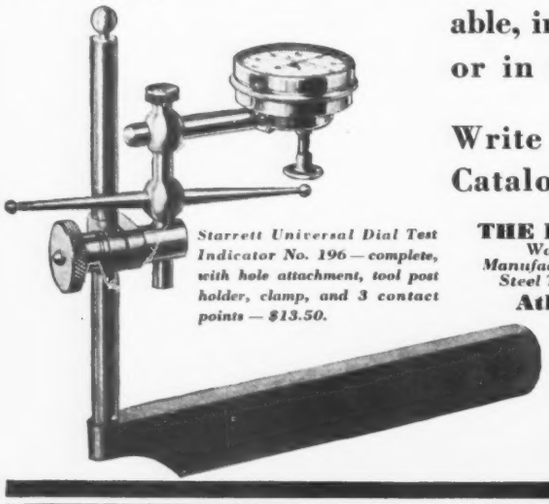
"You were right when you called it a UNIVERSAL"

That's what the best machinists say about the Starrett Universal Dial Test Indicator No. 196.

Hardly a job goes through the shop that won't go through *quicker and with less chance of spoilage* — when No. 196 has had a hand in the work.

Make sure that every one of your men knows about the Starrett No. 196 — and has one available, in his own tool chest or in the crib.

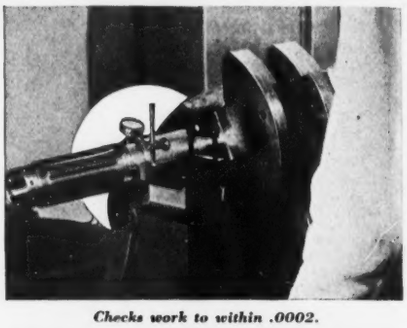
Write for the Starrett Catalog No. 25-D.



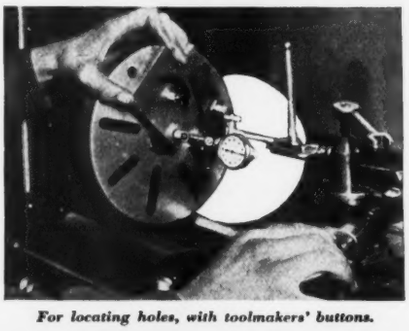
Starrett Universal Dial Test Indicator No. 196 — complete, with hole attachment, tool post holder, clamp, and 3 contact points — $13.50.

THE L. S. STARRETT CO.
World's Greatest Toolmakers
Manufacturers of Hacksaws Unexcelled
Steel Tapes—Standard for Accuracy
Athol, Mass., U. S. A.

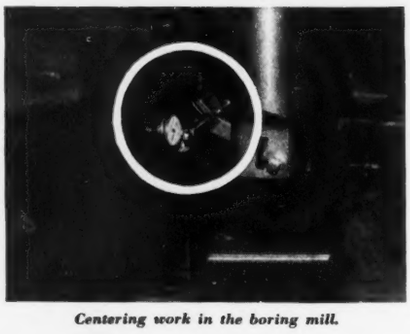
Use Starrett Hacksaws



Checks work to within .0002.



For locating holes, with toolmakers' buttons.



Centering work in the boring mill.

Use Starrett Tools

4949

ANNOUNCING » »

the NEW No. 4 Dumore Grinder

. . . for high-speed precision grinding requirements on small bench lathes

THE No. 4 Grinder is the latest development of the Dumore Engineers, to meet the demand for a precision tool on bench lathes such as the Hardinge Bros., Stark Tool, Rivett, Hjorth, Porter-Cable, etc.

This new grinder is smaller than the No. 5 and No. 7 Dumore Grinders, but possesses all the construction features which have made these grinders famous for precision work.

Shop men will find the No. 4 Dumore adaptable to many difficult and unusual grinding requirements. It is provided with a separable tool post which permits radial and vertical adjustment of the tool. In this grinder the motor and quill may be turned end for end, permitting grinding on either end, and also making it possible to mount the grinder on the back of the machine if desired.

Condensed Specifications

Motor — 1/3 H. P. Continuous duty.
Speed of motor — Approximately 14,000 R. P. M.
Current consumption — Approximately 2.4 amperes.
Size of armature core — 2″ x 2″.
Bearings — Adjustable type with automatic take-up.
Automatic belt tension.
Separable tool post.
Distance from center of tool post to center of spindle — 1⅛″.
Distance from center of spindle to base of grinder (minimum) 11/16″.
Equipment — Two quills, 4X for external grinding, and 4N for internal grinding.

Send the coupon for complete specifications on the new No. 4 Dumore, together with details on our demonstration offer in your plant.

THE DUMORE COMPANY
25 Sixteenth Street Racine, Wisconsin

DUMORE COMPANY
25 Sixteenth St., Racine, Wisconsin

Please send complete details on the new No. 4 Dumore, and information on your demonstration offer.

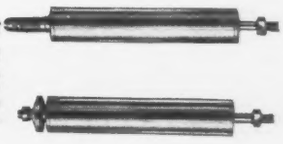
Name.....

Address.....

City.....

State.....

Quill Equipment



Two quills are provided with the No. 4 Grinder, for internal and external grinding on a wide range of applications.

TRADE MARK
DUMORE HIGH-SPEED GRINDERS
REG. U. S. PAT. OFFICE

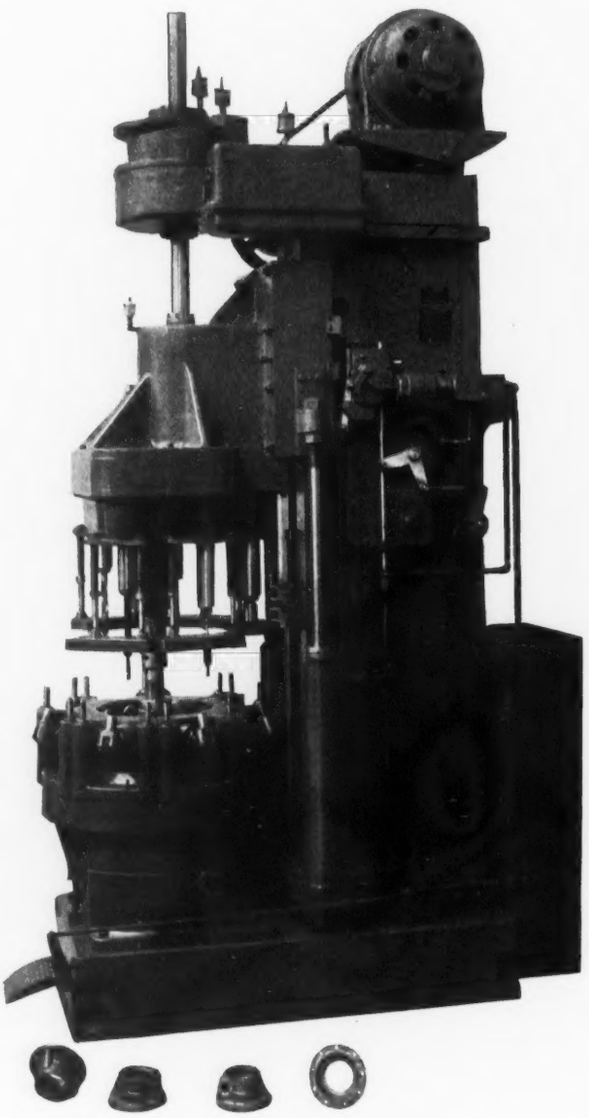
BAKER

BORING AND DRILLING EQUIPMENT

The easiest and in most cases the only way to cut your costs is to install modern methods and equipment. Your competition always has this opportunity and in many cases is taking advantage of it now. This will inevitably force you to do the same; so why delay?

The developments in the Baker line have been far reaching, so that now we can offer a complete line of gear, cam and hydraulic feed machines, either vertical or horizontal, single or multiple spindle; also two- three- and four-way type machines.

Send us your drilling, boring, and tapping problems so we can tell you exactly what this equipment can produce and save for you on your own product.



No. 10-H Baker Hydraulic Feed Machine with 6-spindle head and automatic indexing table for drilling, reaming (2 diameters) and facing (both top and inside boss) malleable iron bearing retainer.

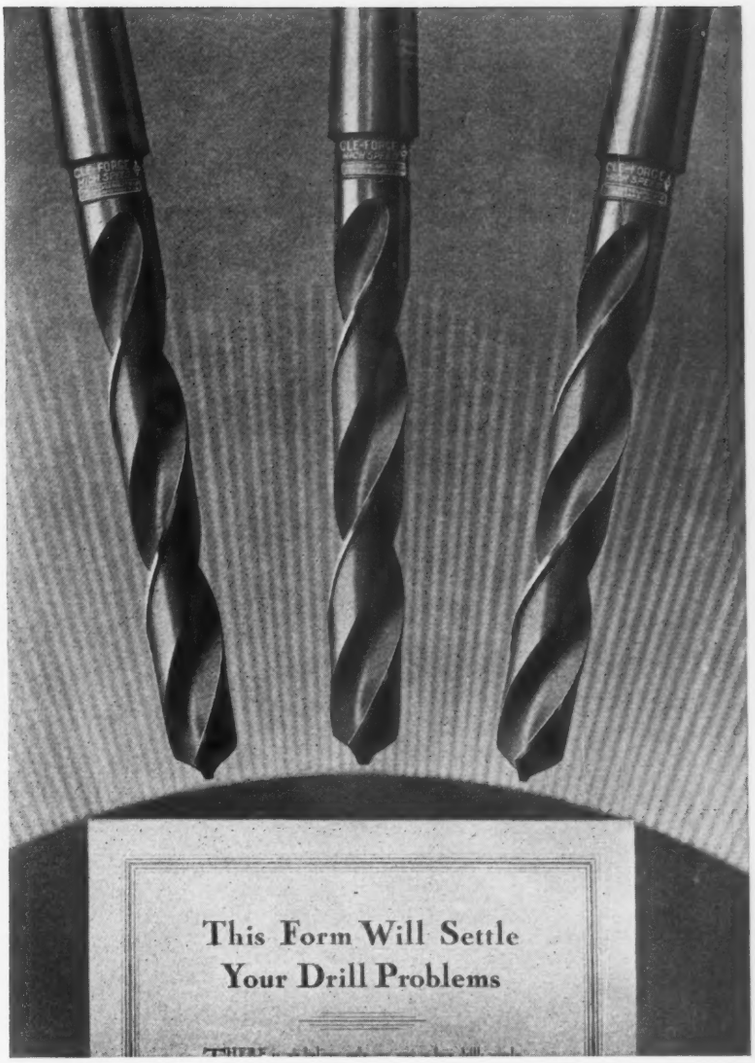
IS YOUR EQUIPMENT AS UP-TO-DATE AS YOUR PRODUCT?

BAKER BROTHERS, Inc., Toledo, Ohio, U.S.A.

Builders of Boring, Drilling, Tapping, Keyseating and Slotting Equipment

• It is significant that piece workers prefer Cle-Forge High Speed Drills to any other. Why? • Because Cle-Forge drills more holes faster and causes operators to lose less time changing dull drills.

For example, in one large plant, it was found that Cle-Forge Drills produced 60 holes between grinds as against 27 holes for drills previously used. The job consisted of gang drilling through high-carbon manganese steel. Management discovered, too, that drilling costs were reduced 56%. • Ask for a copy of our "Cost-per-Hole" Drill Test Form—and let it prove to you that Cle-Forge High Speed Drills are profitable for piece workers, and economical for management.



PIECE WORKERS PREFER "CLEVELAND" DRILLS

Copyright 1931 by The Cleveland Twist Drill Co.

The CLEVELAND TWIST DRILL COMPANY
1242 EAST 49TH STREET
CLEVELAND

TRADE MARK REG. U. S. PAT. OFF. AND FOREIGN COUNTRIES

10 READE ST. NEW YORK 9 NORTH JEFFERSON ST. CHICAGO 654 HOWARD ST. SAN FRANCISCO
LONDON - 35-36-37 UPPER THAMES ST. E.C.4.

Please send "Cost-per-Hole" Drill Test Form, and Performance Digest No. 32. I want to test Cle-Forge High Speed Drills. No obligation.

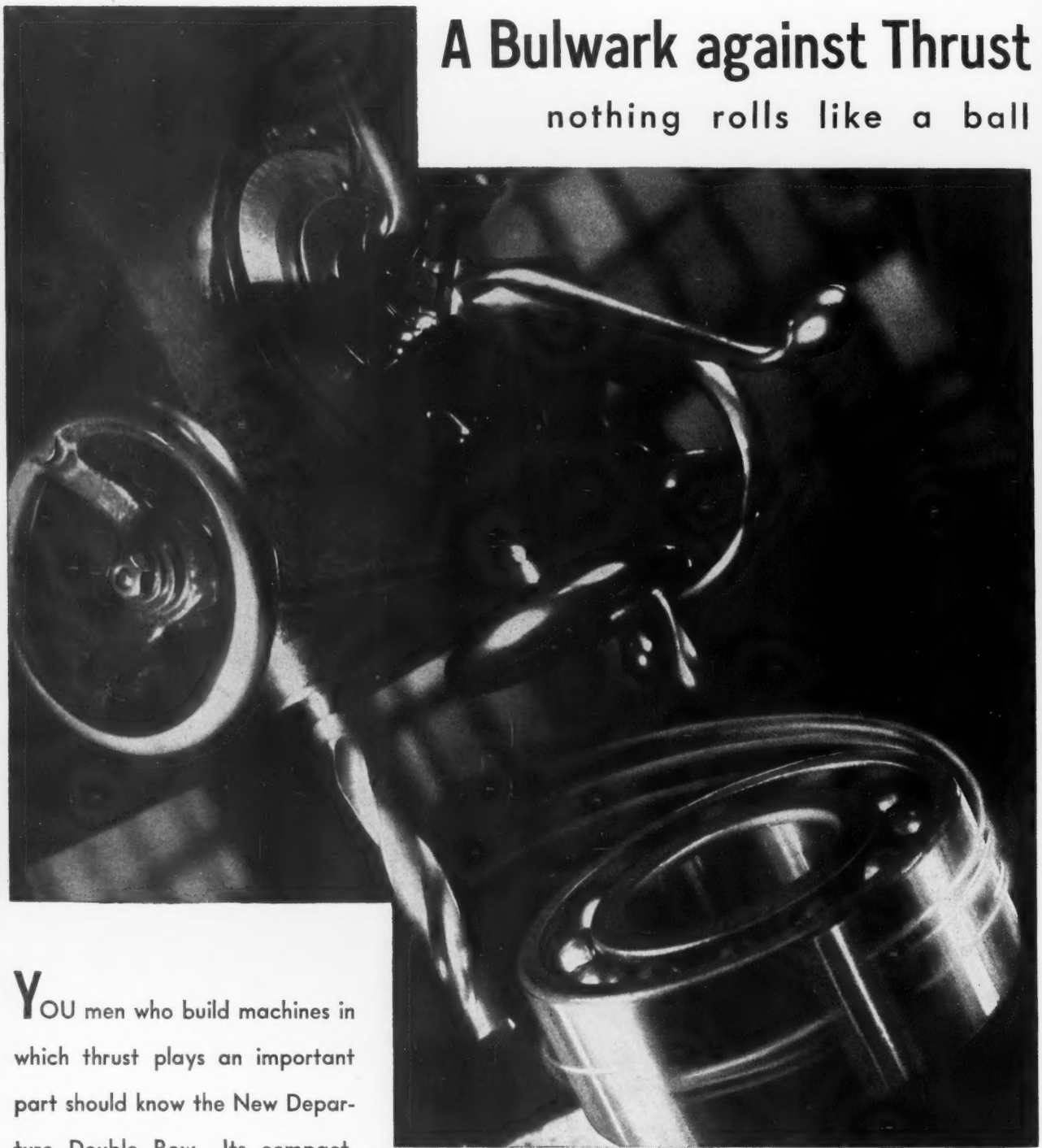
Name_____

Company_____

Address_____

A Bulwark against Thrust

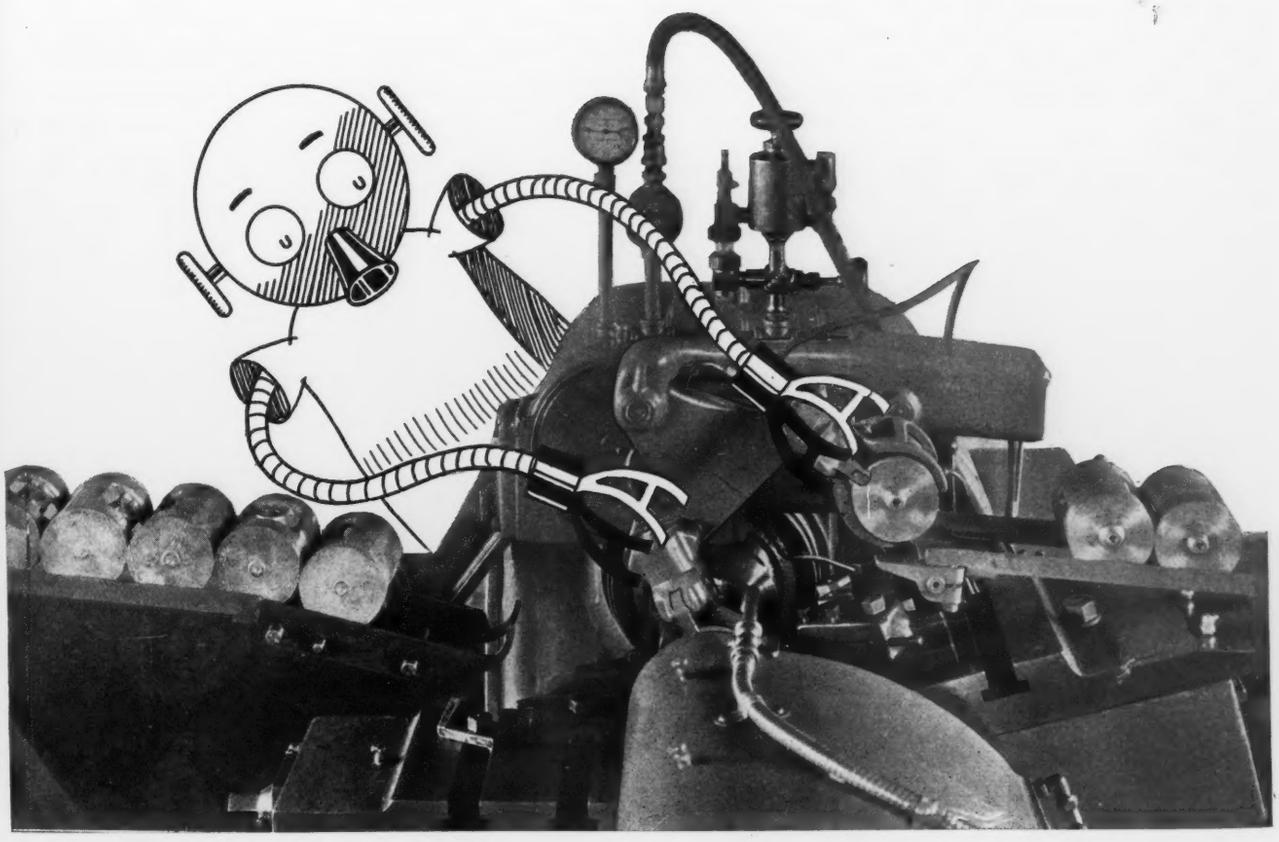
nothing rolls like a ball



YOU men who build machines in which thrust plays an important part should know the New Departure Double Row. Its compact, unified construction helps to simplify mountings and reduce their cost. Preloaded for stability and rigidity, it stubbornly resists deflection, regardless of the direction of load application. An angular contact arrangement of balls and races gives it a very high thrust capacity. And in smoothness, accuracy and speed ability it is typically New Departure. Wherever thrust is a threat . . . use the New Departure Double Row. The New Departure Manufacturing Company, Bristol, Connecticut.

NEW DEPARTURE BALL BEARINGS

1764



Do you know Mr. ROBOT?

If you don't, it's a good time to get acquainted. Now, when sales aren't within shouting distance of 100% you've got to keep costs down. And Mr. Robot can help you do it.

No doubt many of your competitors have *eliminated labor* in turning, grooving and facing pistons. It's up to you to keep *your* costs as low as *theirs*. And the So-swing Robot, with its full automatic operation, is the answer to your problem. One So-swing is worth a battery of ordinary lathes.

For instance, the So-swing Robot is probably the first machine for center turning to apply the principle of automatic loading and unloading. This feature alone has increased production from 300% to 500% in many manufacturing plants. Get *all* the facts. Write Seneca today!

SENECA FALLS MACHINE COMPANY

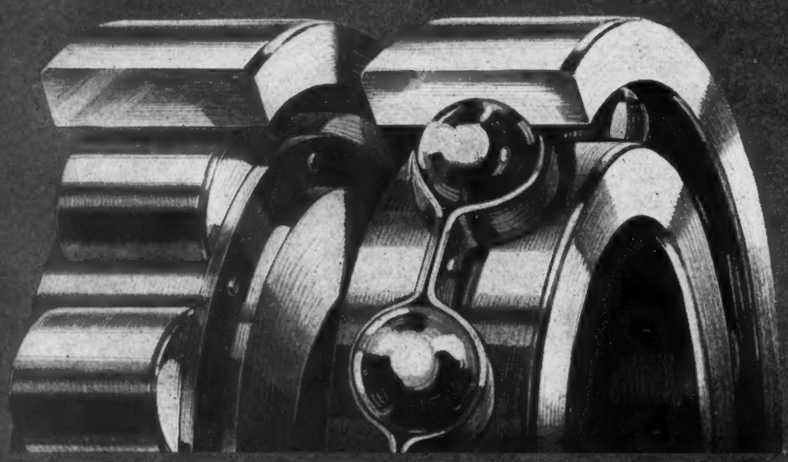
SENECA FALLS *The So-swing People* NEW YORK

Detroit Office: 2832 East Grand Boulevard

EUROPEAN OFFICE: 21 RUE GEORGE SAND, PARIS, FRANCE, IN CHARGE OF GEORGE E. FOGARTY, EUROPEAN SALES MANAGER.

So-swing MODEL U *Full Automatic*

TWIN



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"NORMA-HOFFMANN"

BALL & ROLLER BEARINGS

for any

LOAD - SPEED *or* DUTY

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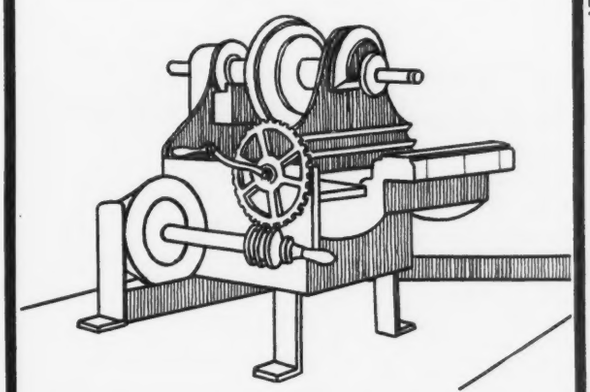
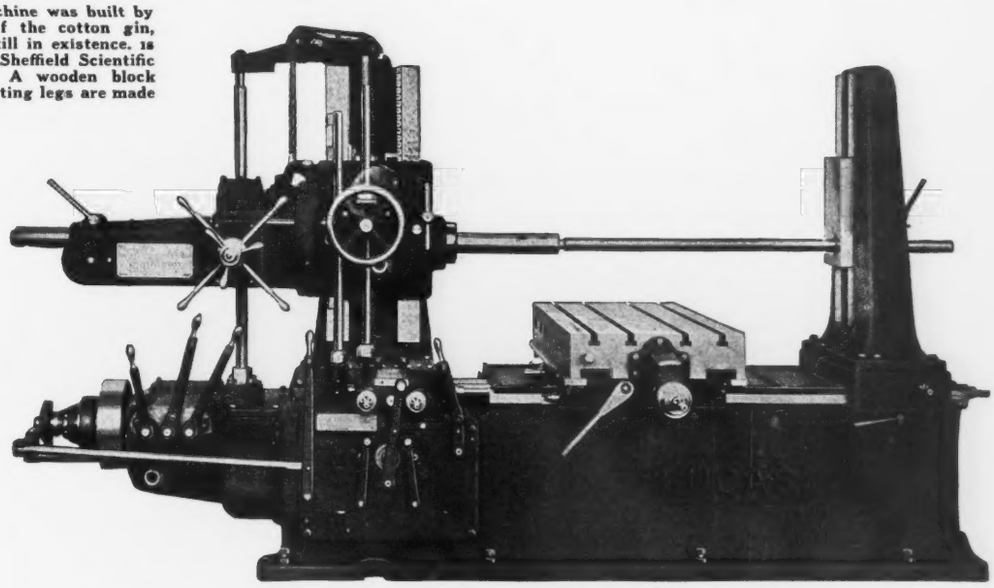
NORMA-HOFFMANN BEARINGS CORPN. - STAMFORD CONN. U.S.A.



THE FIRST MILLING MACHINE
BUILT BY ELI WHITNEY ABOUT 1818

Consider the influence MACHINE TOOLS *have had in developing* MODERN INDUSTRY

The first practical milling machine was built by Eli Whitney, the inventor of the cotton gin, about 1818. This machine, still in existence, is now in the possession of the Sheffield Scientific School of Yale University. A wooden block forms the base and the supporting legs are made of wrought iron.



The Latest Type

LUCAS

"Precision" Horizontal Boring, Drilling and Milling Machine

Write now for a descriptive circular

THE LUCAS MACHINE TOOL CO.
CLEVELAND, OHIO

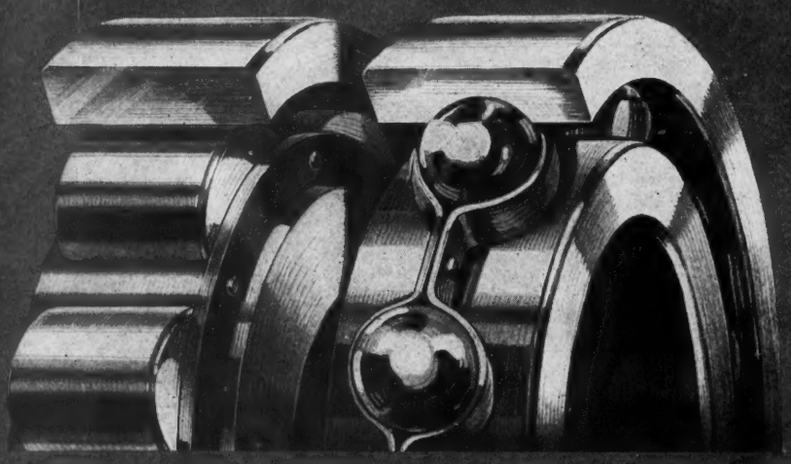
FOREIGN AGENTS: Allied Machinery Co., Barcelona, Zurich. Andrews & George Co., Tokyo. Catmur Machine Tool Corp., Ltd., London, Eng. M. Kocian & G. Nedela, Prague. V. Lowener, Copenhagen, Oslo, Stockholm. Emanuele Mascherpa, Milan, Italy. R. S. Stokvis & Zonen, Rotterdam, Paris.

The profound influence which machine tools have had in the development of industrial life is scarcely realized—even by tool builders themselves. In little more than a century, industry has shown such remarkable progress that today in manufacturing centers the world over, machine shops and plants are equipped to meet the most exacting production demands.

Just as the early inventions of Whitney, Watt, Fulton and Stephenson depended upon the crude machine tools of their time for the "breath of life," so does the speed, the accuracy, the volume of modern production depend upon modern machine tools.

The Lucas is a noteworthy example of the modern machine tool, combining three major functions in one machine. It incorporates many improvements in design and materials which have but recently become available. Replace obsolete machinery with the Lucas. It's a profitable investment every time!

TWIN



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BALL & ROLLER BEARINGS

for any

LOAD-SPEED *or* DUTY

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NORMA-HOFFMANN BEARINGS CORPN. - STAMFORD CONN. U.S.A.

Unequalled Performance at a Low REAL Cost

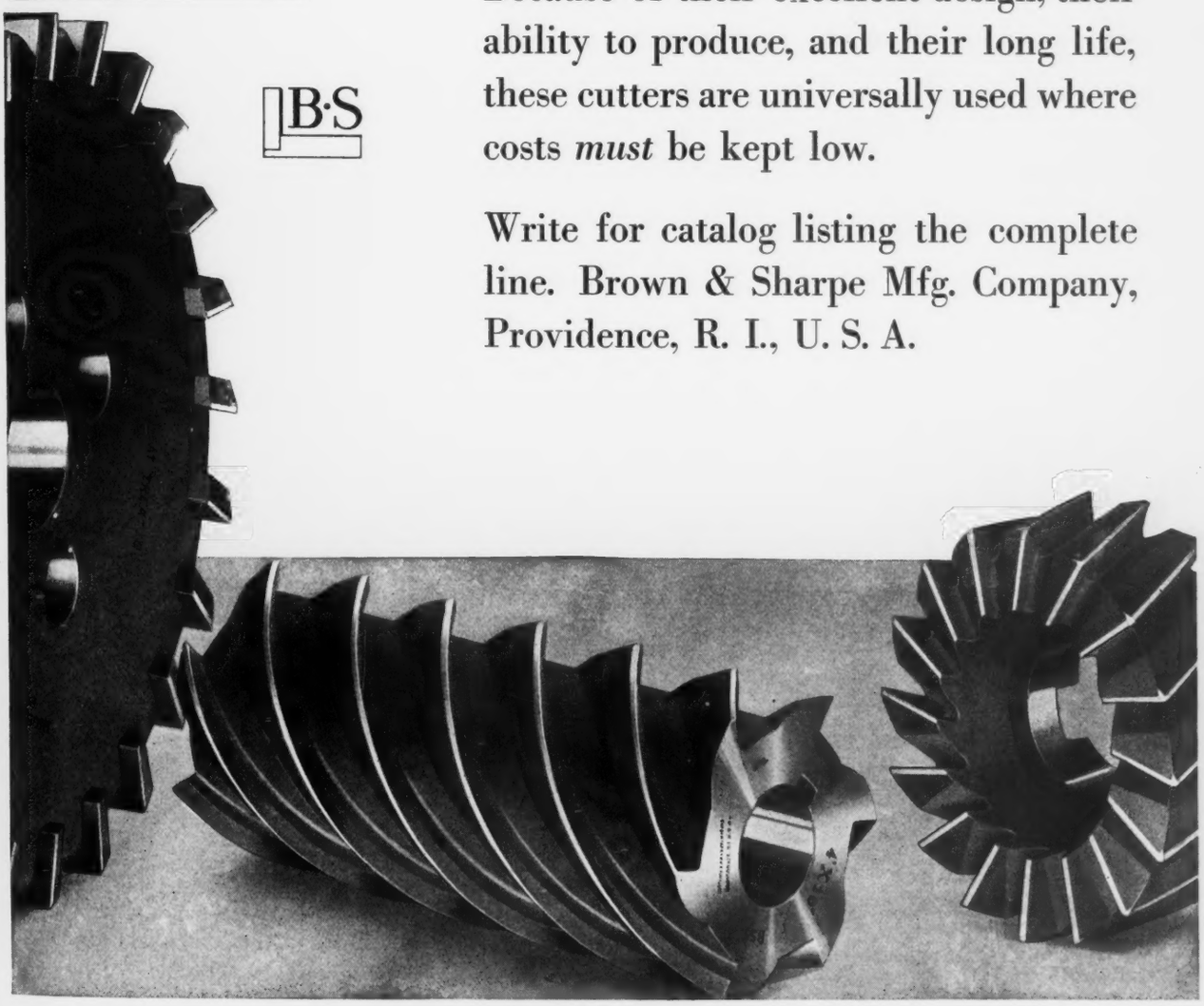
The Cost of
Time Lost Removing Cutters
Plus Time Lost
Replacing Cutters
Plus Lost Production
Plus Sharpening Cutters
Plus Original Purchase
Equals
Real Cost of Cutters

What Is the *Real* Cost of Your Cutters?

Put Brown & Sharpe Cutters on your machines and watch them work. They bring metal to size in the shortest time *and they do it at the lowest real cost.*

Because of their excellent design, their ability to produce, and their long life, these cutters are universally used where costs *must* be kept low.

Write for catalog listing the complete line. Brown & Sharpe Mfg. Company, Providence, R. I., U. S. A.



Brown & Sharpe Cutters

MODERN—EFFICIENT—KEEP COSTS LOW

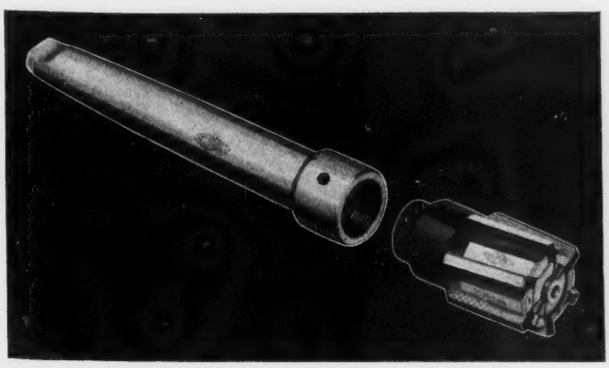
WETMORE

ADJUSTABLE REAMERS

The smallest wheel of the finest Swiss watch is finished with no greater care and precision than is each part of a Wetmore Adjustable Reamer . . . Is it any wonder, then, that those who can recognize supreme quality in a reamer are satisfied with none but a Wetmore?

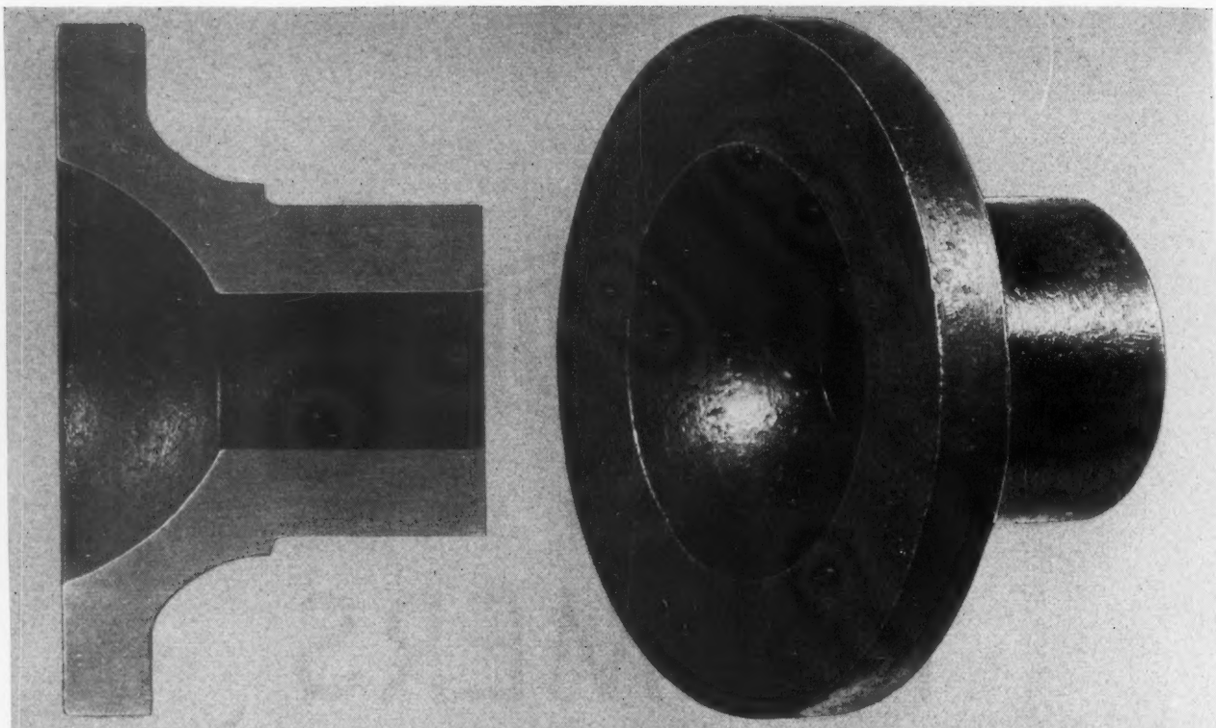
Write for latest catalog of all types of Wetmore Adjustable Machine and Cylinder Reamers and replacement blades.

WETMORE REAMER COMPANY
412 NORTH 27TH STREET MILWAUKEE, WISCONSIN



WETMORE
Type No. 2 ADJUSTABLE REAMER

Left-hand angle blades—high-speed steel, hardened and ground — insure free cutting at all times. Adjustments to .001 inch can be made rapidly and accurately. Micrometer adjusting screw is at front end of body. Adjustable in less time than ordinary reamers. Oversize adjustment insures long life for each set of blades. Solid alloy steel body is heat-treated. Sizes range from 1" to 3", inclusive.



PIERCED TRANSMISSION JOINTS

AJAX Upsetting Forging Machines are producing forgings with accurate concentric holes at considerable cost savings.

This piece requires but three operations. In the first, the bar is nicked where the forging is later to be severed, and the required stock gathered into a disc-shaped upset. In the second, the bar is given a quarter turn, again nicked, and the recessed flange upset to final shape, a nose on the tool starting the hole. In the third operation the moving die shears the forging from the bar at the nicked section, and a punch tool completes the hole.

Corners at the end of the hub are square and there is no drag-in at the hole. The dies, although interlocking and inserted at points of wear, are by no means intricate.

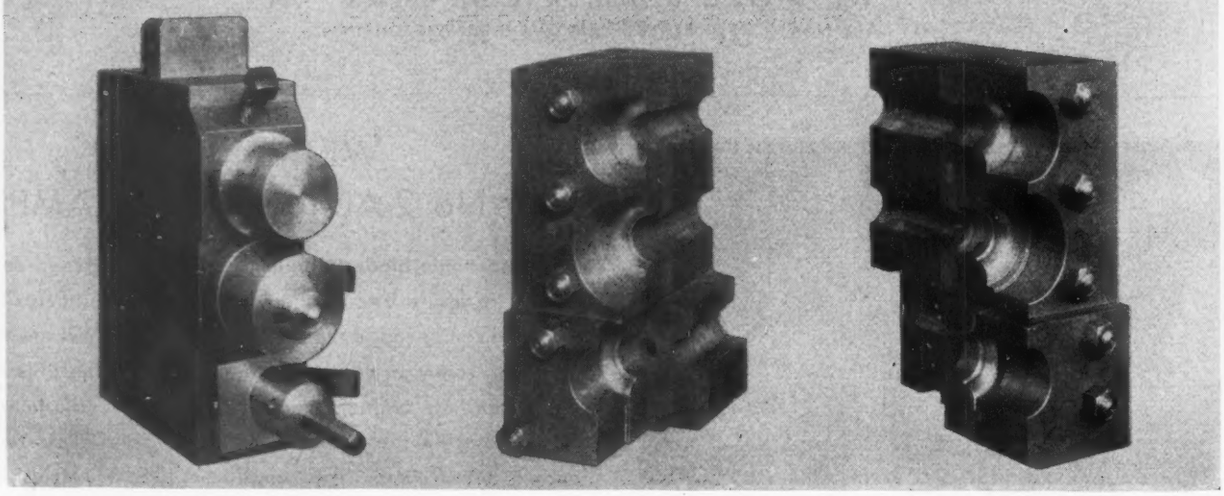
Ajax Engineers, with their wide experience, are at your service to assist you in the design of similar dies.

THE AJAX MANUFACTURING CO.
EUCLID BRANCH P. O., CLEVELAND, O.

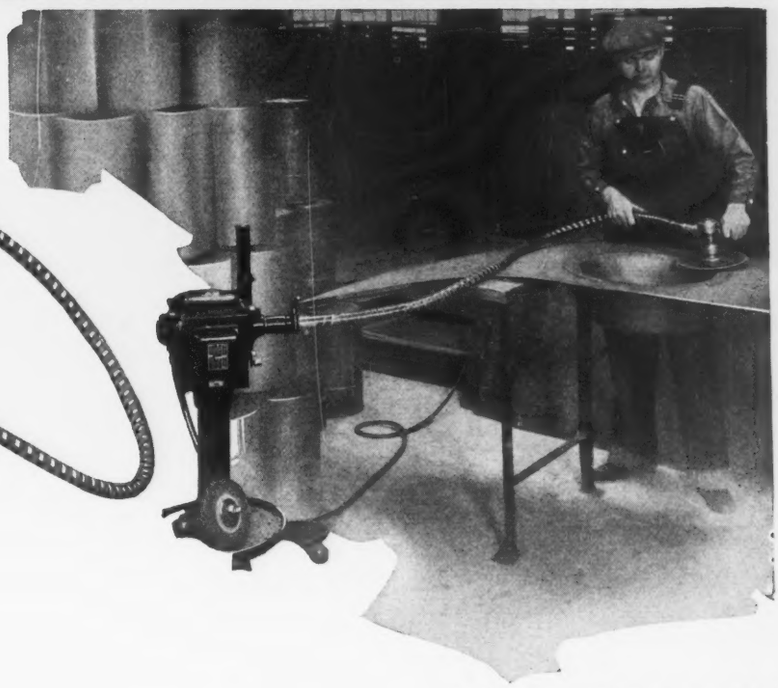
Chicago Office
621 Marquette Bldg.

New York Office
1369 Hudson Terminal

AJAX



QUALITY EQUIPMENT SAVES YOU MONEY



Grinding down weld with Haskins DB-6 Pedestal Type Equipment.

In the leading shops of America *Haskins Quality Equipment* is given the preference. Because with Haskins Equipment work of the most exacting type is quickly and accurately done—continuous service is assured—with freedom from repairs. You can count on Haskins Equipment every working day throughout the year.

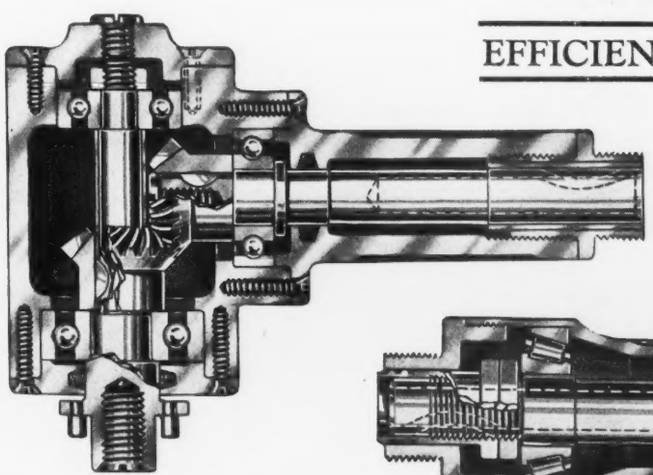
Write for your copy of our 48-page Catalog showing Haskins Equipment and applications.

R.G.HASKINS COMPANY

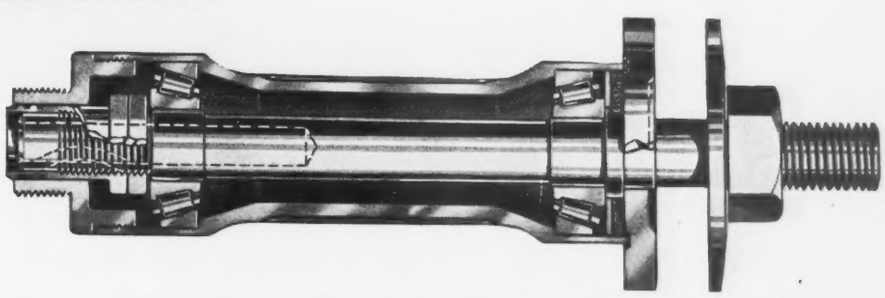
Portable Flexible Shaft Machinery

4634 W. Fulton Street **Chicago, Illinois**

EFFICIENCY—ACCURACY—DURABILITY



We're proud of Haskins Construction Features. Illustrated are cross section views of Haskins right-angle head and spindle. Precision-built for Precision work.



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TO THE ART OF METAL WORKING

"MAXIPRESSING"

Trade Mark

replacing many facing, milling and machining operations

To "finish machine by pressure"; this is the accomplishment of the new National MAXIPRES which marks an epoch in reducing finishing costs.

The definite economy of MAXIPRESSED parts has created a widespread interest in this new and improved method of finishing.

We will be glad to advise you of the economies of MAXIPRESSING in your own plant.

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TIFFIN, OHIO

SOME "MAXIPRESSED" PARTS

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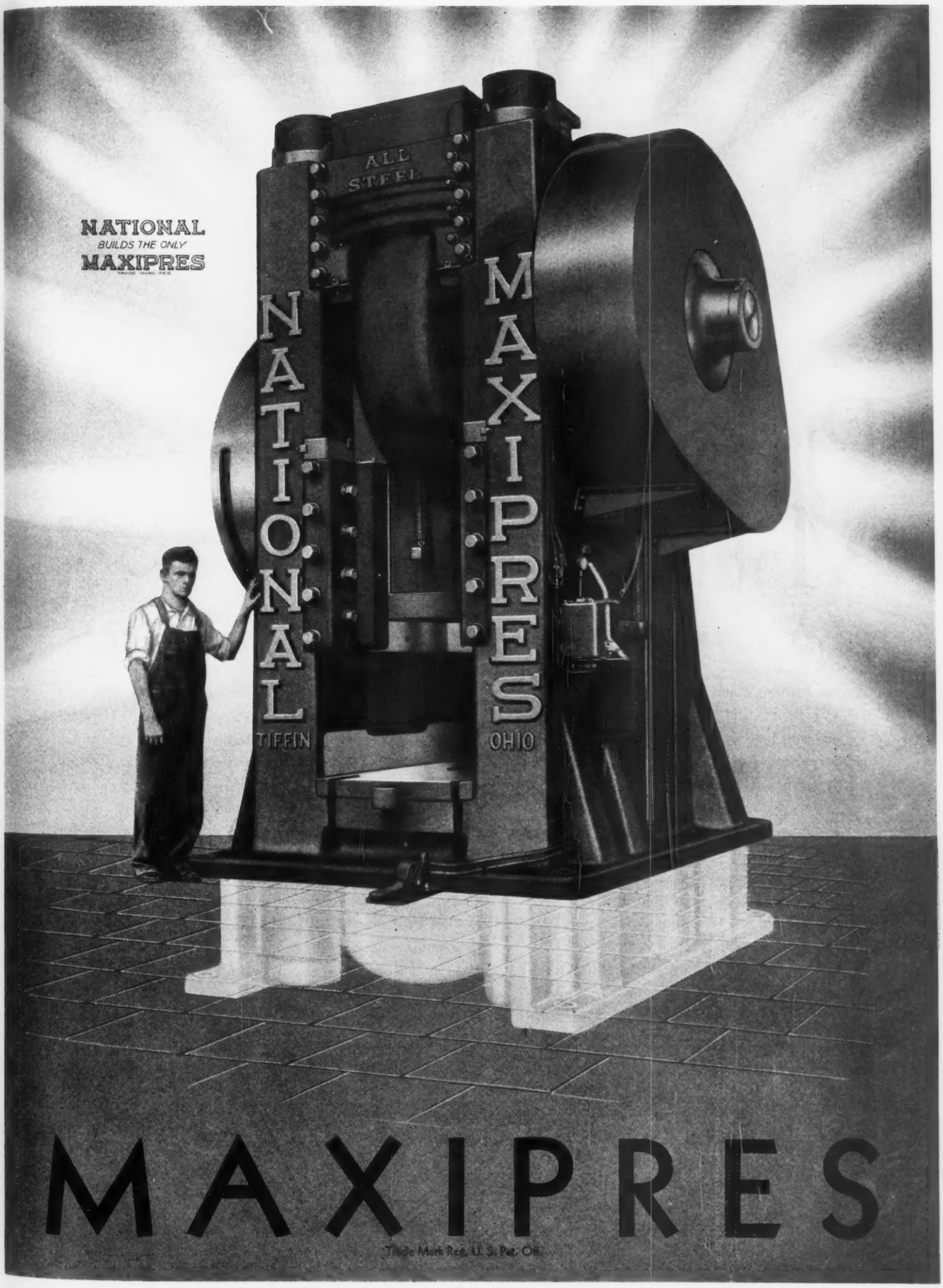
The NEW NATIONAL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BUILDS THE ONLY
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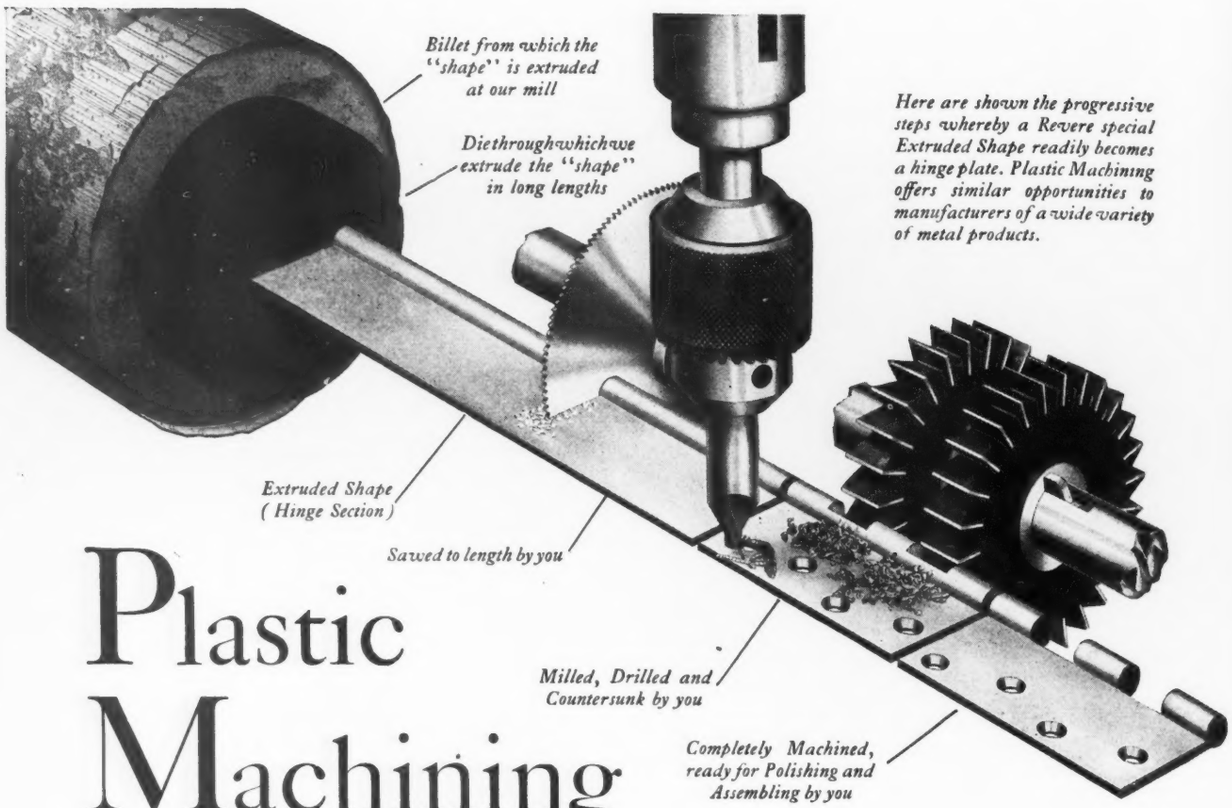
Billet from which the "shape" is extruded at our mill
Die through which we extrude the "shape" in long lengths
Here are shown the progressive steps whereby a Revere special Extruded Shape readily becomes a hinge plate. Plastic Machining offers similar opportunities to manufacturers of a wide variety of metal products.
Extruded Shape (Hinge Section)
Sawed to length by you
Milled, Drilled and Countersunk by you
Completely Machined, ready for Polishing and Assembling by you

Plastic Machining

speeds your production and lowers your costs

Plastic machining means less machining for you. It is, in effect, pre-machining by us while we have the metal hot. When you buy Revere Forgings or Extruded Shapes, you receive metal that is well on its way to becoming your finished part or product.

A Revere "twice-wrought" Brass Forging with but little finishing becomes a valve bonnet—a Revere Extruded Angle, a controller contactor—a Revere Special Extruded Shape, a door hinge. By the use of these twice-wrought Revere Products, you gain the further advantages of uniformity, density, strength, freedom from defects, no rejects, a minimum amount of scrap.

With the uniformity of size and the smoothness of surface obtained in a Revere Forging, rapid handling and accurate work in jigs and fixtures are insured; also, automatic or semi-automatic machine feeding becomes possible.

With special holders or chucks, Revere Extruded Shapes may be fed into turret lathes or screw machines in long lengths, where they may be turned or drilled as readily as concentric rods. Or they may be sawed into short lengths and hot or cold forged with great economy in press operations and with a very material saving in the amount of flash, which is waste.

With your own ingenuity and the aid of our technical staff in studying your problem, we confidently believe the use of Revere Plastic Machining will speed up your production, reduce your overhead, and lower your costs.

Why not start our cooperation with you by writing Revere Copper and Brass Incorporated, 230 Park Avenue, New York City?

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VERSATILITY!

EXAMINE this range of work: Dies, Molds, Punches, Cams, Core Boxes, Metal Patterns, Jigs and Fixtures, Plain Milling, Jigless Boring. *Automatically* done on the Keller Automatic Tool Room Machine.

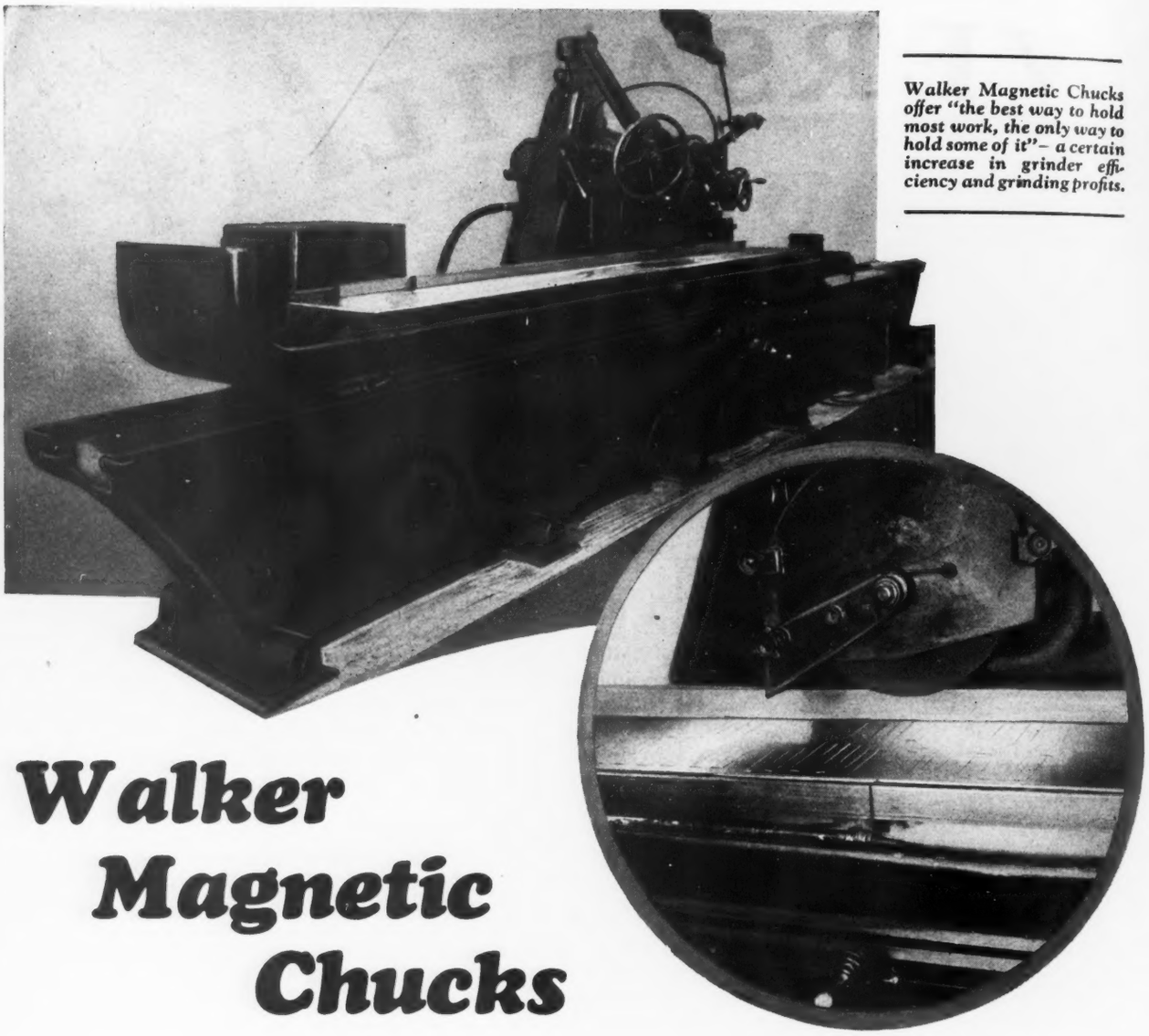
Working to limits that defy human skill—operating always at maximum cutting speeds, the Keller Machine is effecting tremendous economies in all branches of industry.

Its great speed of production assures *accurate* tools when needed—singly or in quantity. It reduces tool replacement costs. Helps maintain a high uniform standard in the finished product. It frees *product* design from the limitations set by *die* costs. Allows the concentration of human skill where it belongs—in *tool design* and *final finishing*. It permits the attainment of peak production with minimum expansion of organization and with no sacrifice of quality.

By the Keller Method, tools will be produced as planned—in time to catch that elusive "demand" for a new or improved product—with a cost sheet that will look just like the estimate.

Write for further information

KELLER MECHANICAL ENGINEERING CORP.
74 Washington St., Brooklyn, N. Y., U.S.A.



Walker Magnetic Chucks offer "the best way to hold most work, the only way to hold some of it"– a certain increase in grinder efficiency and grinding profits.

Walker Magnetic Chucks

For Maximum Production Efficiency on the Modern Grinder

Grinding—the modern finishing method for an almost unlimited field of work, is accurate only if the work is held absolutely rigid in operation; is economical only if setting up requires no costly fixtures, does not waste too much time.

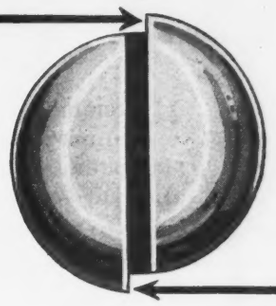
Walker Magnetic Chucks, built in styles and sizes to take large heavy work as well as the thinnest and most delicate parts, completely solves the work-holding problem on grinding operations, insures maximum efficiency for the grinder.

This Walker Magnetic Chuck on a 15" x 15" x 14' Norton Surface Grinder installed at the Textile Machine Works, Reading, Pennsylvania, is a typically efficient modern grinding set-up.

O. S. WALKER CO., INC., WORCESTER, MASS., U. S. A.

SHAKEPROOF
Self Locking Set Screw

The Off-Set Does It!



TOP VIEW

This exaggerated view shows the off-set that insures positive locking.

THE new Shakeproof Self Locking Set Screw does something that no other set screw can do. It *locks itself* and that means it will not loosen, even under the most intense vibration.

The off-set of the slotted end of the screw is the simple secret that makes this amazing performance possible. This off-set creates a spring tension on all threads—producing a positive lock that requires no extra operations to make it secure.

Try this new Set Screw on your own product—give it the hardest possible tests you can devise. Then, you will know how the Shakeproof Self Locking principle keeps connections tight and thus improves performance.

Free trial samples are ready. Mail the coupon for a supply today!

U. S. Patent Nos.
1,764,168
1,767,287
Other patents pending.

SHAKEPROOF
Lock Washer Company

Shakeproof representatives are located in the following cities

New York City Philadelphia Boston
Pittsburgh Schenectady Cleveland Detroit
Toledo Cincinnati Birmingham, Ala.
Dallas, Texas Milwaukee Los Angeles
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Mail This Coupon To-Day

COUPON

Shakeproof Lock Washer Co. *(Division of Illinois Tool Works)*
2553 N. Keeler Ave., Chicago, Ill.
Gentlemen: We want to test your new Self Locking Set Screw. Please send us samples as indicated.

Style of Point..... *Size*.....

Firm Name.....

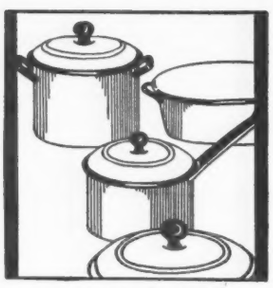
Address.....

City..... *State*.....

By..... *Title*.....

THERE'S AN OAKITE SERVICE MAN NEAR EVERY INDUSTRIAL PLANT

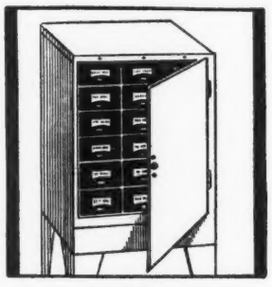
Use this NATION-WIDE OAKITE cleaning service!



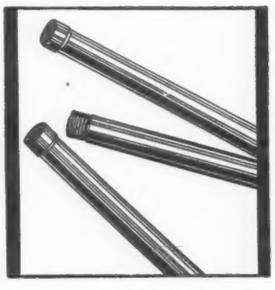
CALIFORNIA

IN removing oil and dirt from sheet metal parts after cutting and stamping, one California maker of kitchenware used approximately 500 pounds of cleaning material per month. When an Oakite Service Man suggested that Oakite would do a better job, the management decided to try it. A solution was made up in their regular cleaning tanks and work was handled in the usual way over a period of several months. When the records were compared, they showed that the amount of Oakite material used was less than half of that formerly required. The work turned out was better, and the time consumed in cleaning was materially shortened.

An Illinois manufacturer of office equipment was having difficulty in removing anti-rust oil from steel filing drawers preparatory to japanning. Naphtha had been used for some time, but it did not prove entirely satisfactory and there was a constant fire and explosion hazard. When an Oakite material was tried, it was found that a short dip in the solution, followed by a cold rinse and a hot rinse left the parts perfectly clean and in excellent condition for japanning. The number of rejects was cut down and costs were reduced. Fire hazard has been completely eliminated.



ILLINOIS



OHIO

An Ohio manufacturer of pipe and metal tubing used caustic soda for some time for cleaning before galvanizing. In an effort to do the work at less cost and to eliminate disagreeable conditions connected with the previous method, the Oakite Service Man was asked for his recommendations. The tank was charged with an Oakite material and improved results were immediately apparent. The plant superintendent stated that the galvanizing was thrown more than an inch further into the ends of the pipe than previously. A brushing machine needed with the former method was discontinued. The cleaning material costs were cut considerably.

Every year since 1909 thousands of concerns have been making definite money savings through the recommendations of Oakite Service Men. Surely you, too, can profit by their experience helping other concerns in your line of work. A post card to us will bring our nearby Service Man to your plant to discuss with you any cleaning, cutting, grinding or rust prevention problem your operations present.

OAKITE PRODUCTS, INC., 26 Thames St., NEW YORK, N. Y.

Oakite Service Men, cleaning specialists, are located in the leading industrial centers of the United States and Canada.

OAKITE

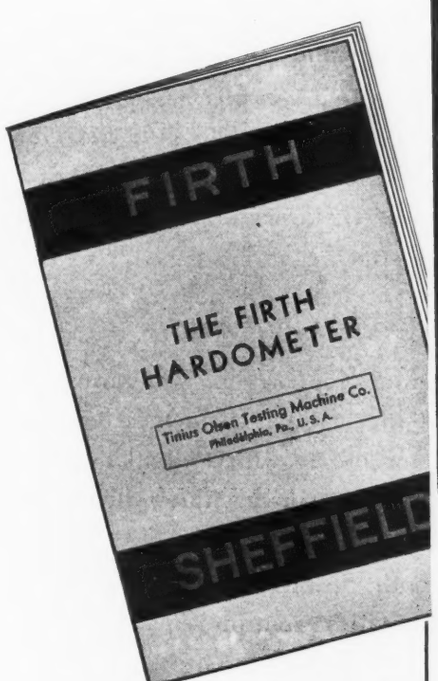
TRADE MARK REG. U.S. PAT. OFF.

Industrial Cleaning Materials and Methods

This Advertisement is one of a series based on actual occurrences.

THERE'S AN OAKITE MATERIAL FOR EVERY KIND OF CLEANING

Are You "UP" on the Latest in Hardness Testing?



The efficiency of modern machines and tools is due to a large extent to the modern methods of hardness testing which by combining laboratory standards of accuracy with manufacturing standards of speed make it possible for manufacturers to know and guarantee metal quality.

Are YOU completely familiar with the latest and most practical methods of hardness testing?

The Firth Hardometer is especially adapted for accurately testing hardness of thin sheets, small objects, and case hardened or cyanided surfaces.

Bulletin No. 1 describes Standard Brinell testers, Herbert Pendulum and "Cloudburst" equipment, and other machines and instruments for hardness testing on gold, rubber, hardened steels, and other materials from lead to sapphire.

The latest hardness testing methods and the newest machines sponsored by Olsen experts are explained and illustrated in these two recent publications, which should be in every engineering reference library.

Use the coupon for your copies.

TINIUS OLSEN TESTING MACHINE COMPANY
500 N. 12th Street, Philadelphia, Pa.

Gentlemen:

Send me a copy of Olsen Bulletin No. 1 and a copy of the Firth Hardometer Book.

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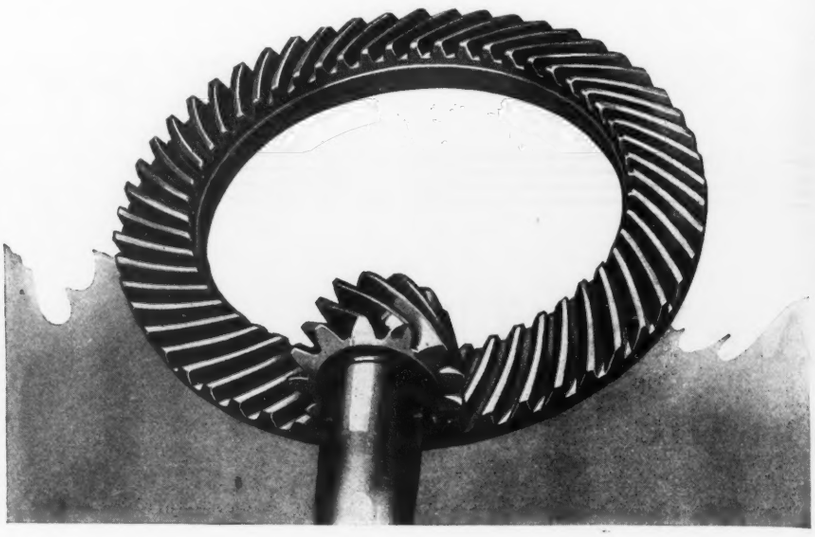
Spiral Bevel Gears

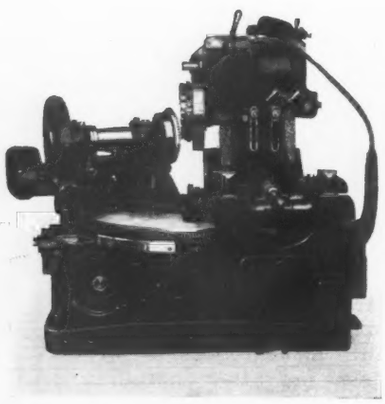


FOR UNEQUALLED QUIETNESS

Spiral Bevel Gears are extremely quiet in operation. When properly designed and cut, they have a continuous pitch line contact with several teeth in mesh at one time.

The shock of transferring the load from tooth to tooth and the sudden change of tooth pressure, which are manifested by noise and vibration especially noticeable at high peripheral speeds, are both absent in Spiral Bevel Gears. The teeth, instead of striking in full contact at once, engage smoothly and quietly.

The wear of Spiral Bevel Gears is practically negligible due to their rolling action and correct tooth profiles. The gear and pinion are both correctly generated on Gleason Machines by rolling the work with the revolving cutter or reciprocating tool in the same manner that a gear rolls with a crown gear.



This machine, which employs a circular cutter, will correctly generate Spiral Bevel Gears up to 18″ Pitch Diameter, 10—1 Ratio, 2½ D. P. and 1¾″ Face. Tilting adjustments on the cutter head make it possible to use one cutter for several different jobs. It is fully universal and can be used for generating gears in either large or small quantities.

Spiral Bevel Gear Generators

The Gleason Works builds machines for correctly generating Spiral Bevel Gears from ⅜ inch to 90 inches Pitch Diameter. Gears up to approximately 30 inches diameter are cut with a circular cutter of the face mill type and larger gears are cut on machines which employ a single tool.

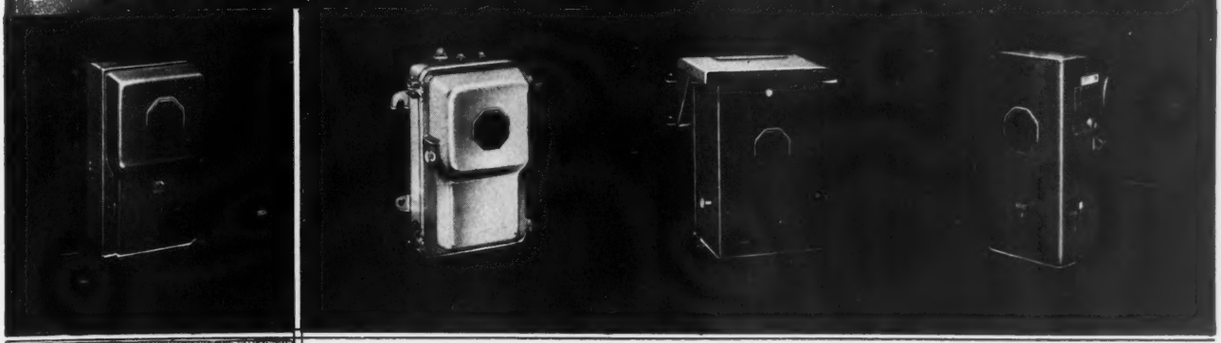
Complete information on both Spiral Bevel Gears and the machines on which they are cut, will be sent on request.

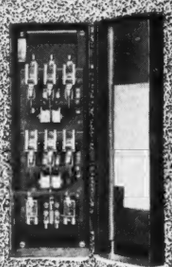
GLEASON WORKS

Builders of Bevel Gear Machinery for Over Sixty Years

1000 UNIVERSITY AVENUE, ROCHESTER, N. Y., U. S. A.

STANDARD CABINETS FOR BULLETIN 710 AUTOMATIC STARTERS





This is the Bulletin 710

Across-the-line Starting Switch

for A.C. motors larger than 5 horsepower

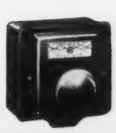
Every manufacturer of large motorized machines should be acquainted with the Bulletin 710 Automatic Starter.

It is the only starter on the market equipped with the patented Inducto-therm overload relays. This Allen-Bradley invention operates on the transformer principle. It maintains its guaranteed accuracy irrespective of time in service or number of operations. The Inducto-therm relay is adjustable over a wide range by merely turning a small thumb screw. There is nothing to get out of adjustment — nothing to replace — no thermal elements to fuse — nothing to burn out.

You surely want the best and most reliable starting equipment on your machines. Therefore, send for Allen-Bradley Bulletin 710. As illustrated above, the Bulletin 710 starter can be furnished in cabinets for any industrial application.

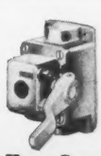
Allen-Bradley Co.
1331 S. First St., Milwaukee, Wis.

Allen-Bradley Pilot Controls Can be Furnished for Every Job



Automatic Pressure Switch

Push Button with Pilot Light



Heavy Duty Control

Standard Station

LOOK CLOSELY!

"This man has discovered a better means for holding pipe"

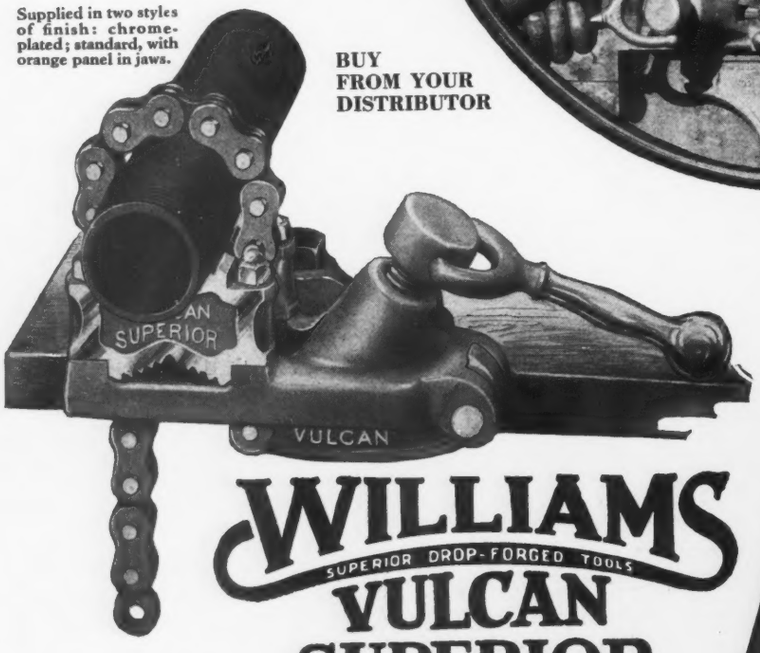
Here's a common sense pipe vise design — so simple and natural in its action that users wonder why someone never designed vises this way before.

With "Vulcan Superior" you have everything "above the bench" —ready at hand. *Convenient* for rapid operation. A sturdy tool, wholly made of tough wrought steel, with reversible jaws which provide *double service.*

Two sizes, No. 11 for pipe 1/8 to 2½ inches and No. 12 for 1/4 to 4½ inch pipe—either size having 1/2 inch greater capacity than other vises of corresponding size. Ask for literature.

J. H. WILLIAMS & CO.,
"The Drop-Forging People"
75 Spring St., New York

Supplied in two styles of finish: chrome-plated; standard, with orange panel in jaws.



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SUPERIOR DROP-FORGED TOOLS
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CHAIN PIPE VISE

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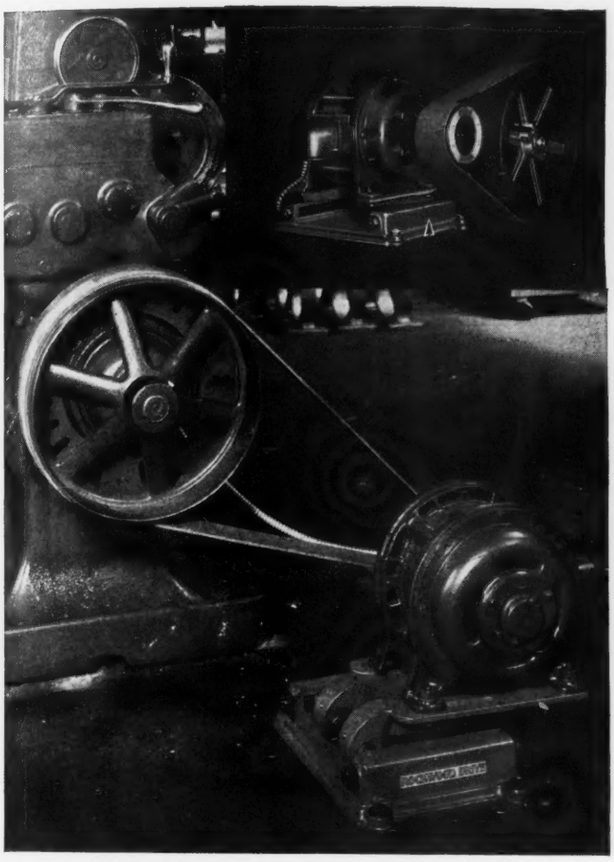
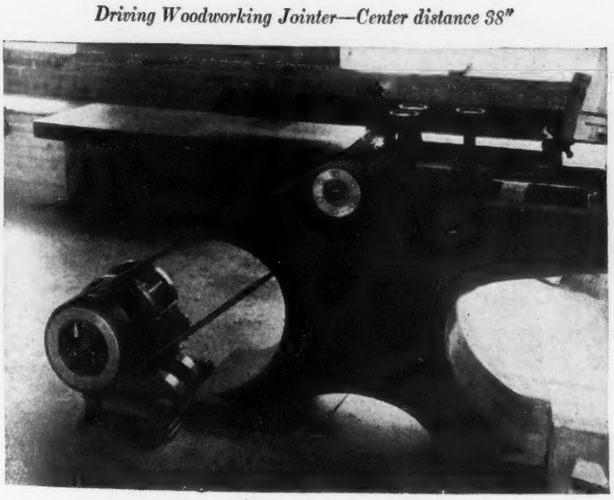
An Easy Way to Motorize Your Machines



Driving Milwaukee Universal Miller—Center distance 24"

ROCKWOOD
SHORT-CENTER FLAT BELT DRIVE

Driving Woodworking Jointer—Center distance 38"



● It's no trouble at all to equip your machines with an efficient individual-motor drive.

Just bolt a ROCKWOOD Drive base on the floor (or wall, or ceiling)—tighten four bolts and the motor is mounted—pass a flat belt from the motor pulley to the machine pulley—align the pulleys by a quick, simple adjustment—turn on the current, and the drive is at work!

No fussing with gears and chains. No bothering with special shaped pulleys and belts. In fact, not a single part of the driven machine need be disturbed. Think of the convenience—and the saving in cost!

The ROCKWOOD Drive, with its pivoted motor base, enables you to use a flat belt for a short-center drive of unequalled dependability. The weight of the motor maintains *correct* and *uniform belt tension*. This automatic tension control assures *constant* speed and *constant* pull—the basic requisites for efficient machine performance!

After you place your first ROCKWOOD Drive into service, you'll agree that no other short-center drive offers so many advantages. Many plants are ordering additional ROCKWOOD Drives within the first week. Progressive machinery builders are adopting this distinctly better drive as standard equipment.

Choose from the complete range of standard ROCKWOOD Drives, for motors from 1 to 50 H. P.—any speed ratio, any center distance desired. Immediate delivery! . . . Larger sizes, and special mountings for machinery builders, also available.

THE ROCKWOOD MANUFACTURING CO., Indianapolis, Ind.
THE OHIO VALLEY PULLEY WORKS, Inc., Maysville, Ky.
Divisions of General Fibre Products, Inc.

● MAIL COUPON FOR FREE SIZE BOOK

THE ROCKWOOD MANUFACTURING CO., *Indianapolis, Ind.*
OR THE OHIO VALLEY PULLEY WORKS, *Inc., Maysville, Ky.*

I want full information on the modern, efficient ROCKWOOD Short-Center Drive. Please send Book E-31, giving complete specifications and prices.

Name.....

Company.....

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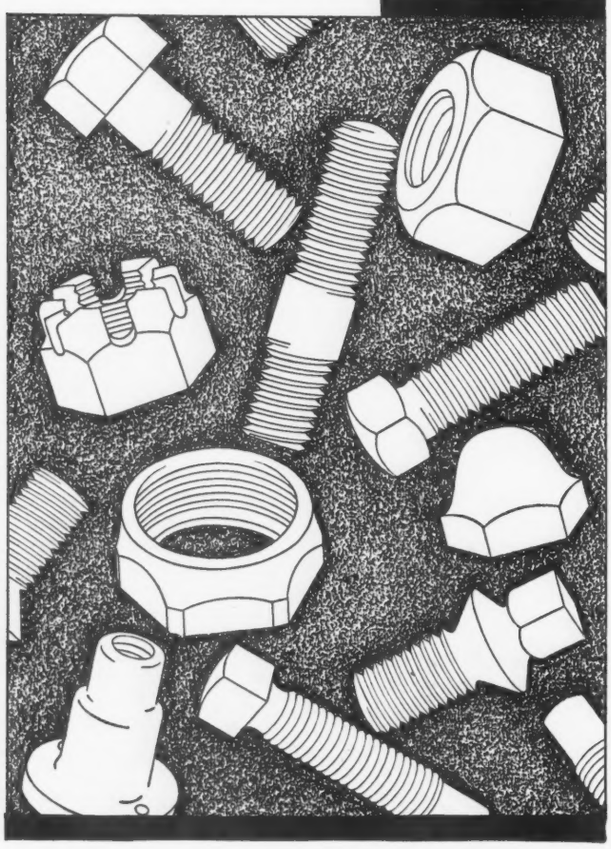
MACHINABILITY

THAT PROMOTES CONTINUOUS AUTOMATIC MACHINE PRODUCTION

J&L STEEL COLD FINISHED



THIS ACCOUNTS FOR THE WIDESPREAD ACCEPTANCE OF J & L BESSEMER SCREW STEELS

Tool changes, tool grinding, machine adjustments—all these take toll from production, all these depend directly on the machinability of the stock that is used. J & L Bessemer Screw Steels, known and noted for uniformly superior machining qualities, cut such down-time to a minimum.

Exhaustive research backed by 81 years of iron and steel experience disclosed the properties required to attain outstanding machinability. J & L ownership-control of all raw materials and processes of manufacture from ore to finished product assures that every piece of stock will have these properties. All J & L Bessemer Screw Stock is made in the same plants—by the same men—under the same processes, to the end that each piece will duplicate every other in chemical and physical characteristics, and serve with uniform satisfaction.

J&L STEEL

JONES & LAUGHLIN STEEL CORPORATION

AMERICAN IRON AND STEEL WORKS

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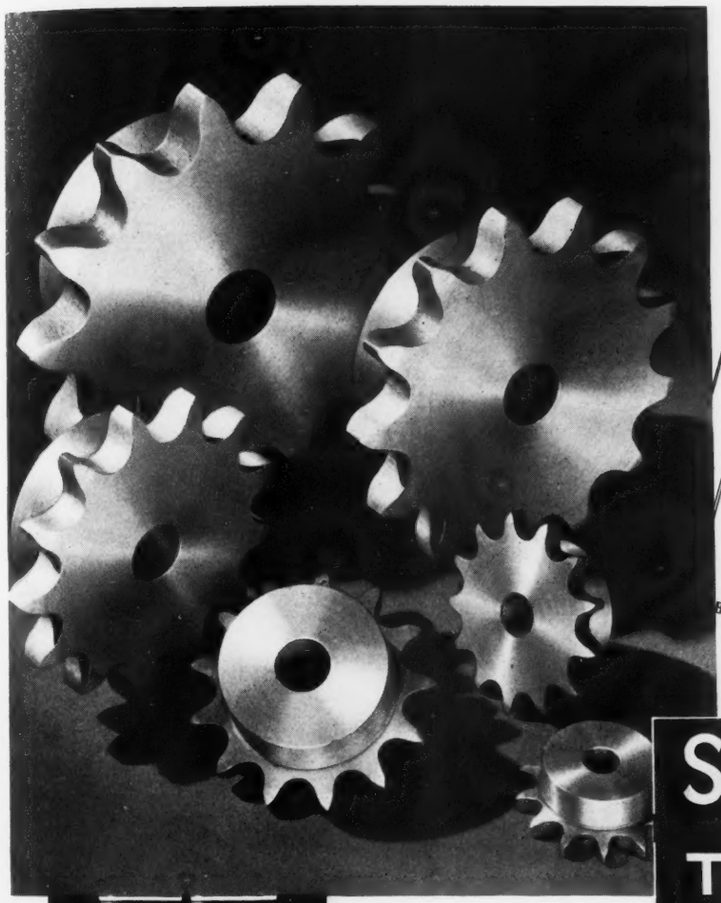
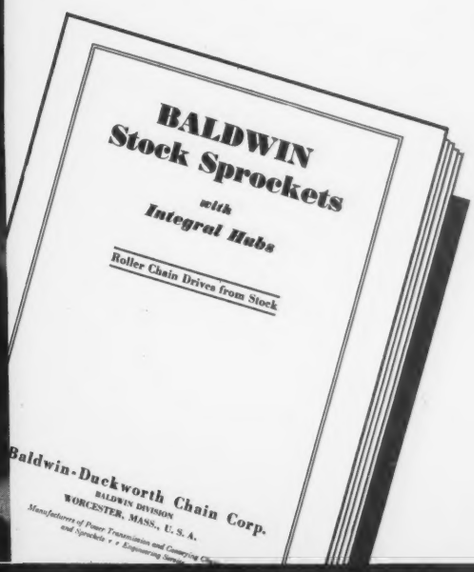
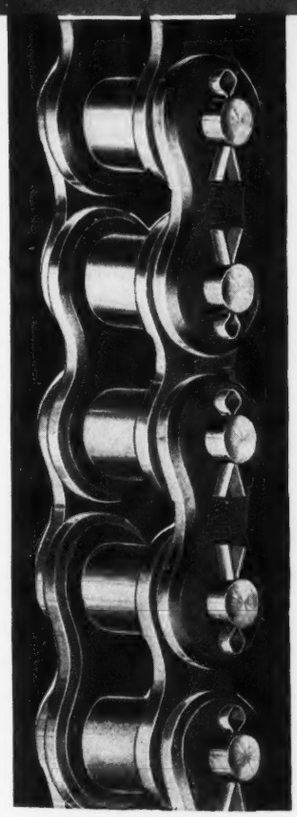




SPROCKETS— THE KEYS TO CHAIN LIFE



Correct Tooth Design and ***Accurate Machining*** are the major reasons why ***Baldwin Sprockets*** actually lengthen the life of your roller chain.

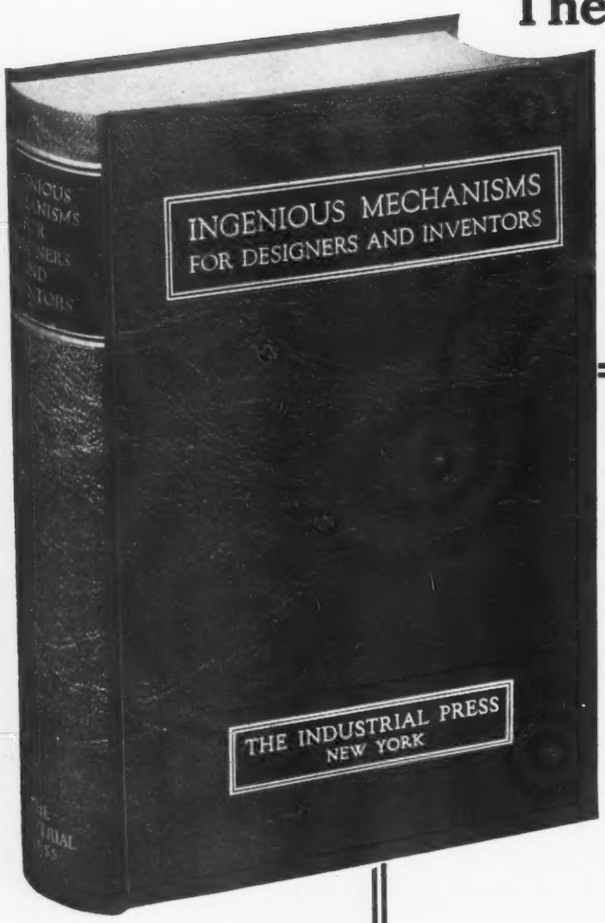
Baldwin sprocket teeth are as accurately spaced and cut as the teeth of a precision gear. Hub holes are absolutely true, thus eliminating the "wobble" and mis-alignment that cause excessive wear on both sprockets and chains.

The new booklet—"Baldwin Stock Sprockets with Integral Hubs"—gives complete data on Baldwin Roller Chain Drives—all sizes and ratios. Send today for your copy, addressing the main office or your nearest Baldwin distributor.

BALDWIN-DUCKWORTH CHAIN CORPORATION
BALDWIN DIVISION, WORCESTER, MASS.
DUCKWORTH DIVISION, SPRINGFIELD, MASS.

BALDWIN DUCKWORTH

The Combined Experience of One Hundred and Ten Designers and Inventors in all parts of the world has gone into this book



"Ingenious Mechanisms for Designers and Inventors"—one of the latest of MACHINERY'S books—is the most complete work of its kind ever published. A wide variety of the most unusual and ingenious mechanisms ever devised is described in this treatise. The descriptions are confined to important elements or units in automatic machine design and are right to the point and easily understood. The mechanisms are grouped in chapters according to general types, which facilitates finding whatever class of mechanical movement is desired.

A Complete Course of Study

The mechanical devices described have actually been applied to many different kinds of automatic machines. This book provides a complete course of study for designers, draftsmen, and students. The cleverest ideas of 110 designers and inventors, in all parts of the world, are clearly set forth—all illustrated with detailed drawings—making it easy to acquire an expert knowledge of the general subject of mechanisms. Some idea of the broad scope of the work may be gained from a glance at the chapter headings listed below.

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Overload Relief Mechanisms and Automatic Safeguards
Interlocking Devices
Driving Mechanisms for Reciprocating Parts
Quick-return Motions for Tool Slides
Speed-changing Mechanisms
Differential Motions
Straight-line Motions
Miscellaneous Mechanical Movements
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M8-31

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HEAVY arcing, oxidation, and burning of contacts—all the troubles that affect ordinary single-break starters—are well guarded against in the C-H 9586 "AAA" Twin-Break Starter. All contacts are twin-break, cutting the voltage rise in two. The remaining pin-point arc is snuffed out in the deep non-removable thermoplax pockets. The eight contacts are not merely plated but actually are "shod" with blocks of pure silver which carry full current continuously, even on severe inching service, with little temperature rise.

With such a starter, the motor and machine are driven to the highest pitch of production, yet this starter infallibly guards against dangerous overloads, performance which is even more understandable after a study of the eight individual Twin-Break Starter features listed below—performance which is typical of the entire C-H Starter line.

Install C-H Control on your equipment; ask for it on the motorized machines you buy. Electrical wholesalers in principal cities stock C-H Control. CUTLER-HAMMER, Inc., *Pioneer Manufacturers of Electric Control Apparatus.* 1295 St. Paul Ave., Milwaukee, Wis.

FEATURES OF C-H 9586 "AAA" STARTER

1. Heavy silver twin-break contacts render oxidation harmless. Operate on severest inching service at maximum h. p. Carry rated current with less than half permissible temperature rise.

3. Twin-break contacts halve arc voltage.

Accessories should match Control —in Quality

Control Accessories save steps, permit machines to be run faster, often expand the possibilities of automatic operation. Since they are so vital a part of the motorized machine, select them with the utmost care. Specify Cutler-Hammer Control Accessories . . . designed by Control Engineers to function supremely well with good motors and good Control.

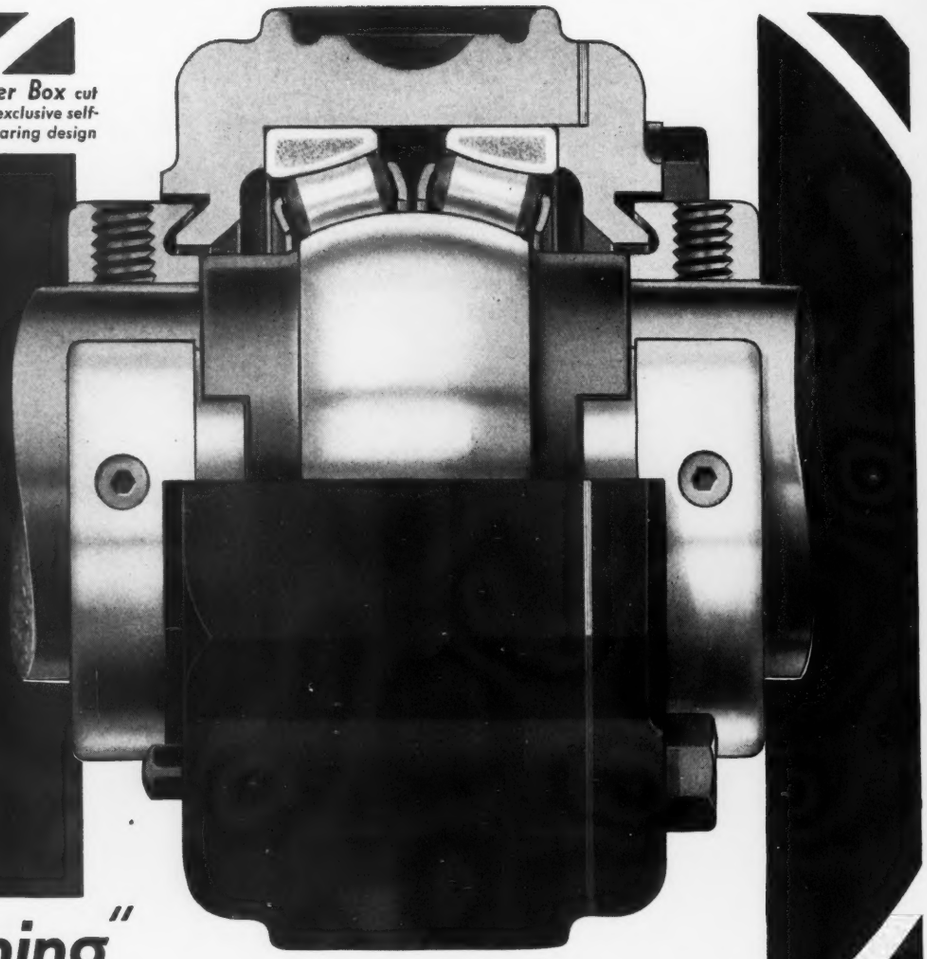
Bulletin 10251, C-H foot-operated push button with normally closed or normally open contacts.

CUTLER HAMMER

C-H

The Control Equipment Good Electric Motors Deserve

(A-4149)



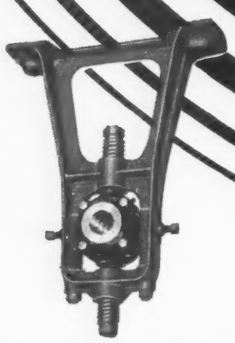
Shafer Hanger Box cut away to show the exclusive self-aligning roller bearing design

"Self-aligning"

means extra service

It means less friction, greater reliability, lower cost in lubrication and labor — when you use Shafer Roller Bearing Hanger Boxes. Only Shafer Hanger Boxes give you this compact self-aligning roller bearing with its generous load capacity and its free-rolling action even in the presence of shaft deflection or misalignment.

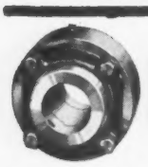
SHAFER BEARING CORPORATION
6501-99 West Grand Avenue Chicago, Illinois
Branch Stock: 173 Lafayette Street, New York City



A full range of stock sizes to fit all 4-point hangers makes it easy to get these advantages in your plant. Write for Catalog No. 12 with full data.

SHAFER
SELF-ALIGNING ROLLER BEARINGS

These Shafer Roller Bearing Units are carried in stock in a full range of standard sizes


Cartridge Unit

Take-up Unit

Pillow Block

Conveyor Roll

Duplex Unit

Flange Unit

M8 Gray

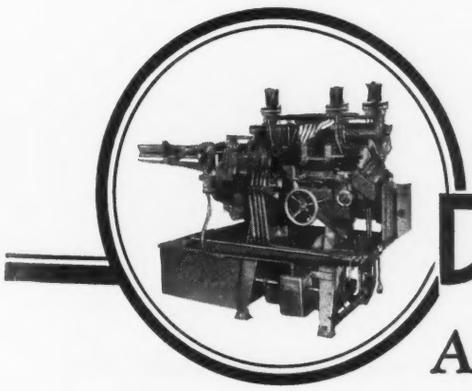
A *Single* Operation

produces perfect burr-less parts like these on a DAVENPORT

It was about time that an outstanding automatic screw machine—such as the Davenport—produced screw parts that were not only accurate but *finished.* So we developed the Davenport Burring Attachment. Now parts like those above are pouring out of Davenports ready for use—in a *single operation,* and the time and money formerly expended in second (burring) operations are invested in more production—or saved altogether.

This is really a mighty important development, and we want you to know all the details—particularly about the Burring Attachment's additional abilities on "back-end" work.

Your request will bring complete information



DAVENPORT MACHINE TOOL CO., INC.
ROCHESTER, NEW YORK

DAVENPORT
5 Spindle
Automatic Screw Machine

Good Marks Require Good Stamps

To put a good, clean, legible mark in metal requires more than just a steel stamp—it calls for a good steel stamp. And that stamp is a Thor!

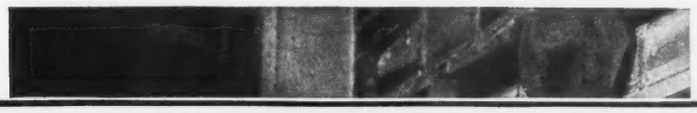
If we were making a machine tool we couldn't design it more carefully than we have the Thor —or use better materials—or build in more convenience and dependability.

Thors are made from the finest vanadium steel, correctly heat-treated (as shown by the blue head) and beveled to eliminate sting. Their characters are hand-engraved for uniformity, marked on the side of the stamp itself for ready identification and deeply cut so they will go in deep.

These are just a few reasons why Thor users get "more marks per dollar." Our catalog, sent on request, contains many more.

"The Stamp With a Blue Head"

The Pittsburgh Stamp Co., 810 Canal St., Pittsburgh, Pa.



No Wonder the Polisher Realizes Its Superiority when—

—Its surface tenacity saves him money on his glue bill—"TP" stays put until worn out.

—Its ready packing saves him work and worry in setting up his wheels.

—Its surface tenacity cuts his grain costs—because "TP" has greater glue adhesion—stays with the wheel longer—does more real downright cutting.

—Its freedom from flats, plates and splinters saves him from loss from lazy non-productive grain. "TP" is all good.

—Its uniformity as to hardness, sharpness and controlled grading saves him from losses due to uneven polishing results and scratching.

—Its extreme angularity gives him a grain, every granule of which is on the job to do its share of the work—to give greater production per set up.

And remember, please, that "TP" is a High Surface Tenacity Polishing Grain, originated by The Carborundum Company

ALOXITE Brand "TP" Polishing Grain

REG. U. S. PAT. OFF.

IT CUTS, WHILE IT HOLDS, WHILE IT POLISHES

THE CARBORUNDUM COMPANY, NIAGARA FALLS, N.Y.

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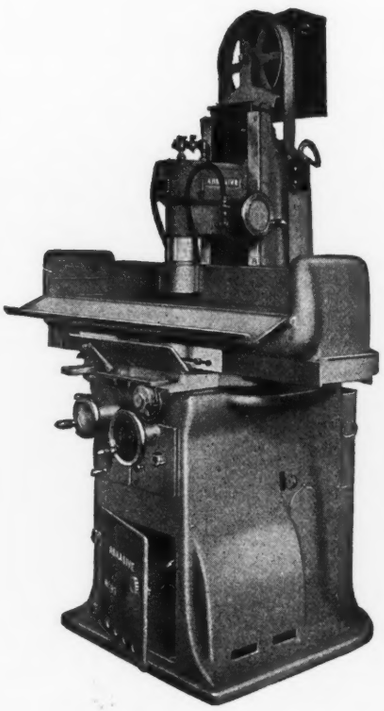
ABRASIVE

Oh Boy! When business does come back, won't we all have to hustle to build up those depleted stocks! And what have we got to do it with? A lot of old, worn-out machine tools?

Look around. Let's be *prepared.*

Abrasive Machine Tool Co.
East Providence, R. I.



No. 33 Surface Grinder
22" x 7" x 12"

Grand Rapids No. 10B Combination Tap and Drill Grinder

Motor driven. Grinds Taps from No. 6 to 1½"—Twist Drills ⅛" to 1½"

It does the work of two machines

Grand Rapids Grinders

If you grind both drills and taps why maintain two machines when a Grand Rapids Combination Drill and Tap Grinder does the same work more economically? It is fast, accurate, modern in design, occupies a minimum of floor space, and is inexpensive to buy. Write for full details.

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Abolish Expensive Hand Finishing

with a

Simplex-A Abrasive Band Grinder

This Grinder accelerates production and cuts costs. Hand emerying or filing operations are antiquated in comparison. The use of this new modern machine assures straight grain finishes with sharp edges. Details of this and other styles and sizes on request.

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Grinding Wheel Dressers

We manufacture the only complete line of Dressers and Cutters. Write for our new Catalog.

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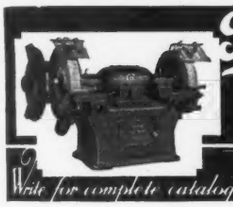

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ELECTRIC GRINDERS · BUFFERS
PORTABLE ELECTRIC TOOLS

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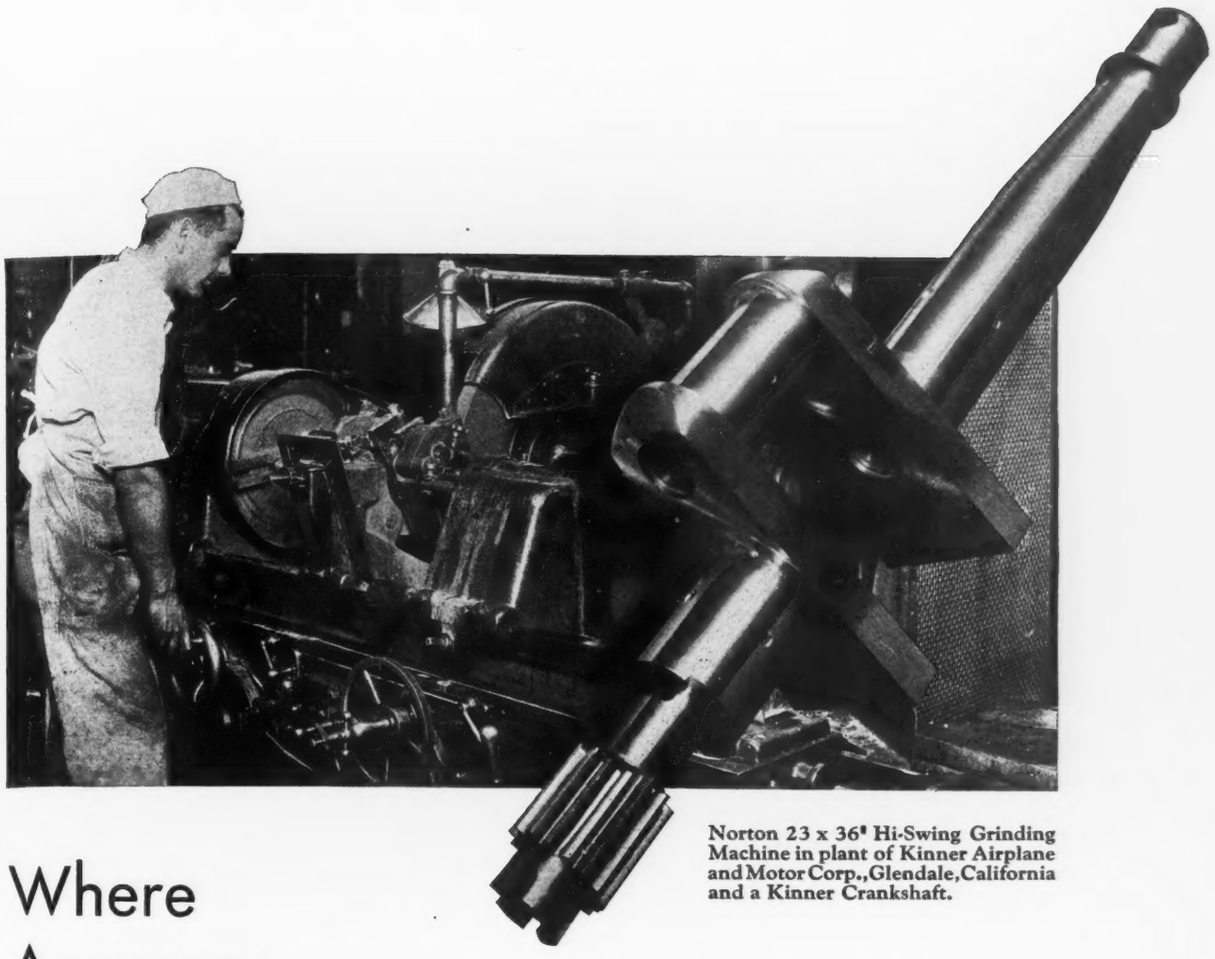
Cincinnati, Ohio, U.S.A.



Norton 23 x 36" Hi-Swing Grinding Machine in plant of Kinner Airplane and Motor Corp., Glendale, California and a Kinner Crankshaft.

Where Accuracy Is of Utmost Importance

THE majority of the leading manufacturers of radial airplane motors have selected the Norton Hi-Swing Grinding Machine for finishing crankshafts—a vital part of their motors.

The machine is specially designed for this type of crankshaft and prospective manufacturers of airplane motors are invited to request full information and specifications.

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M-280

NORTON PRODUCTS—Grinding Machines; Lapping Machines :-: Grinding Wheels; Abrasives for Polishing; Pulpstones; India Oilstones :-: Refractories; Porous Plates :-: Norton Floors—Alundum Tiles and Aggregates

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MANY TYPES AND SIZES

Capacities ⅛ to 2 H.P. Vertical and Horizontal.

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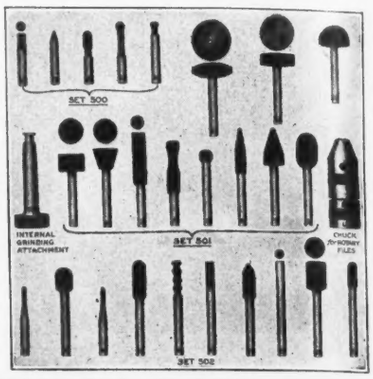

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This Grinder Gives Maximum Service

With this 12"-x 36" Thompson Universal Grinder you can do surface, edge, internal, die, cutter and reamer grinding—also plain grinding between centers. Operating cost is very low, production fast, and there are five table speeds from a self-contained 3 H.P. motor.

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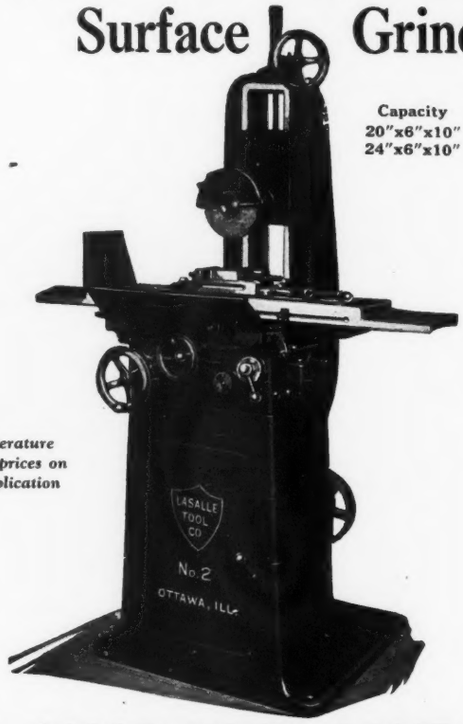
1534 W. Main St., SPRINGFIELD, OHIO, U. S. A.

La Salle No. 2 Automatic Surface Grinder

Capacity
20"x6"x10"
24"x6"x10"



Literature and prices on application

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CUSHION ABRASIVE WHEEL

STRIPS OF ABRASIVE CLOTH—REPLACED IN 10 SECONDS—WITH OUT REMOVING WHEELS—REDUCE POLISHING COSTS 50%

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DURABLE
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OVER 3000 IN USE

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Floor Grinders, Tool Grinders, Knife Grinders, Shear Blade Grinders, Face Grinders, Swing Frame Grinders, Radial Grinders, Wet and Dry Grinders, Slitter and Disc Grinders, Buffing and Polishing Lathes and many special grinders. Also high grade Grinding Wheels, including the famous Bridgeport Sectional Wheels.

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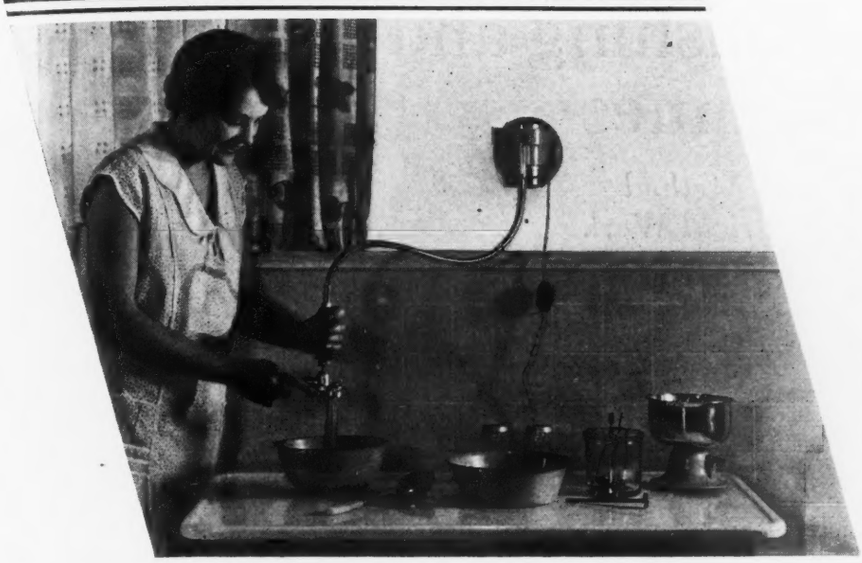
We make the regular Huntington (Pattern) for all sizes. Roughing for Nos. 1 and 2. Paragon for No. 1 only.

GEORGE H. CALDER CO., Lancaster, Pa., U.S.A.



Meet The Wife-Saver!

—a neat, handy, safe, labor-saving kitchen appliance. Reliability in the shaft is of course very essential. It is assured by the use of S. S. WHITE Shafts.

S.S.WHITE Flexible Shafts
make devices like this practicable

This housewife is happy with her WIFE-SAVER, product of the SpeedWay Mfg. Co., of Cicero, Ill. It's so neat and simple and takes the drudgery out of so many kitchen tasks.

Best of all, it never gives her any trouble. The manufacturer made sure of that by equipping the WIFE-SAVER with S. S. WHITE Flexible Shafts, — shafts that have long been noted for their high quality and unfailing reliability.

The WIFE-SAVER is only one of many recently developed machines and devices which the reliability of S. S. WHITE Shafts has made practicable. More and more, designers and manufacturers are beginning to realize the possibilities of flexible shafts and are capitalizing on them.

Read the partial list of existing applications of S. S. WHITE Shafts. It will give you some idea of the broad scope of possibilities and will undoubtedly suggest many other desirable applications for which the flexible shaft is ideally suited.

Standard S. S. WHITE Drive Shafts ranging from the light .041" size to the powerful ¾" diam. shaft, together with a wide variety of couplings and casings, meet the requirements of practically any application. At the same time the Company is equipped and prepared to make special shafts to suit specific requirements.

Complete data on S. S. WHITE Shafts will be furnished on request. Full and capable engineering co-operation is also offered for the working out of any unusual application. Inquiries are invited. Address them to

The S.S.WHITE Dental Mfg. Co.
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Partial List of Applications S. S. WHITE FLEXIBLE SHAFT

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Valve Grinding
Screw Slotting
Milling
Glass Cutting
Testing
Portable Grinding
Concrete Surfacing
Paint Scraping
Floor Scraping
Engraving
Shoe Making
Animal Shearing
Hair Clipping
Massaging
Washing
Linotype
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Jewelers' Lathes
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Moving Picture Cameras & Projectors
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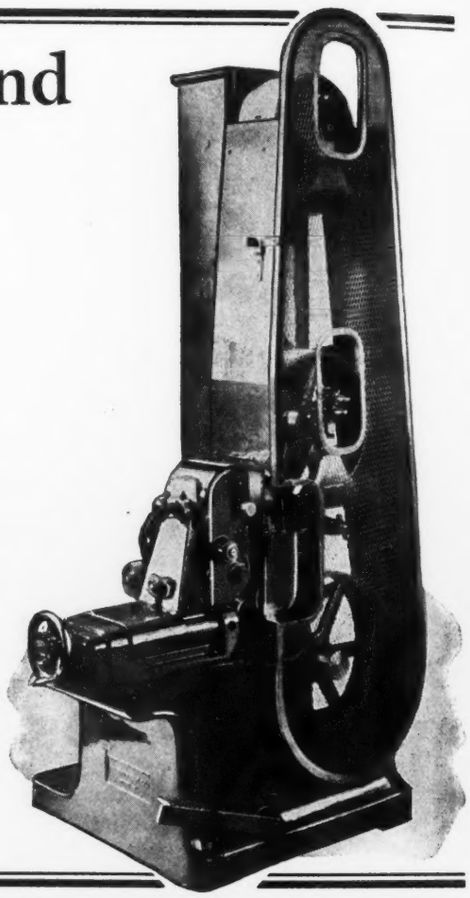
Gun Fire Controls
Valve Controls
Searchlight Controls
Engine Governors
Windshield Cleaners

Production Polishing and Finishing Machines



The Quality Economy Method For Tapered and Cylindrical Work

Feeding tapered or cylindrical parts in a steady stream across the abrasive belt with quality of finish controlled by the grain and grade of the belt, is the easiest, most economical and at the same time, most efficient finishing method.

Production Polishing and Finishing Machines are simple and fool-proof, adjustments for different diameters are easily and quickly made. Capacity to 6″ diameter in metal, wood, hard rubber, bakelite and any other hard surfaced material.

Send for details and send sample for polishing and production estimates

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These Shears Cannot Come Apart or Bind—They're
GRANT RIVETED
Sanitary, Durable Economical Equipment for Home, Hospital and Shop
GRANT MANUFACTURING & MACHINE CO.
A Garden This Year?
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That are Built t
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GRANT RIVETERS
Help Chase "Blue Monday" from the Modern Housekeepers' Week
GRANT MFG. & MACHINE CO.

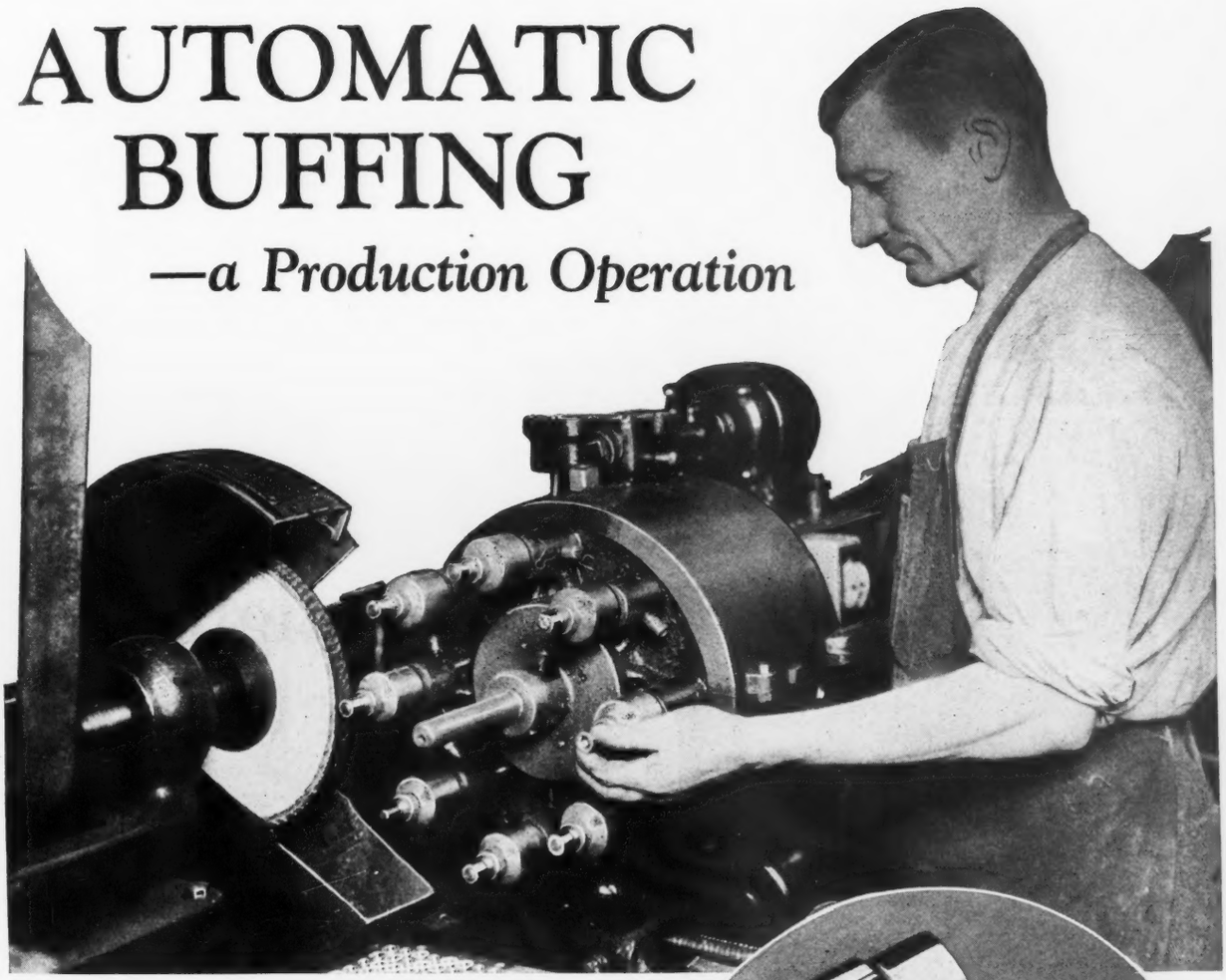
A few examples of the profitable application of Grant Rotary Vibratory Riveters and Grant Noiseless Rivet Spinners.

Send for details of Grant Riveters and some installations in your own field.

THE GRANT MFG. & MACHINE CO., N. W. Station, Bridgeport, Conn.

AUTOMATIC BUFFING

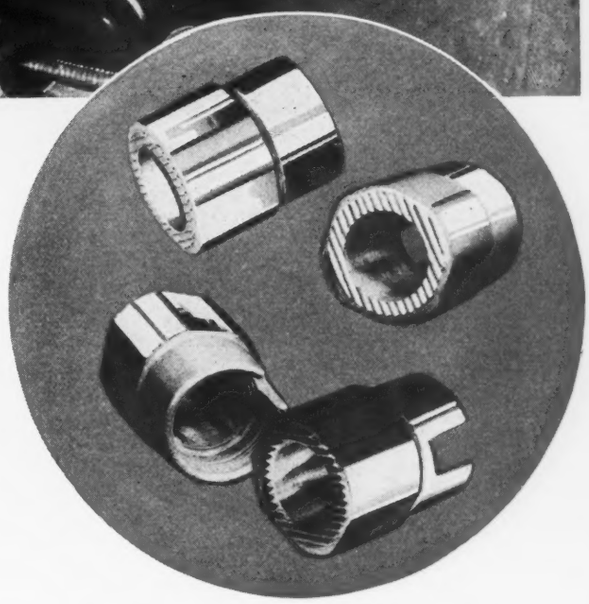
—*a Production Operation*



UNIFORMITY of finish as well as extraordinarily low cost is the rule wherever large or small work can be buffed or polished the "Automatic Way."

The advantages of quantity buffing on Automatic Buffing Machines are particularly obvious on the type of work shown here. Small, odd shaped—hand operation would figure as an over large proportion of the production costs, while with Automatic Buffing, on the other hand, this operation becomes a negligible item instead of a drain on profits.

Automatic Buffing Machines are widely (but not universally) applicable. Our engineers will be glad to give you a frank and unprejudiced opinion as to whether they can be profitably applied to *your* work.

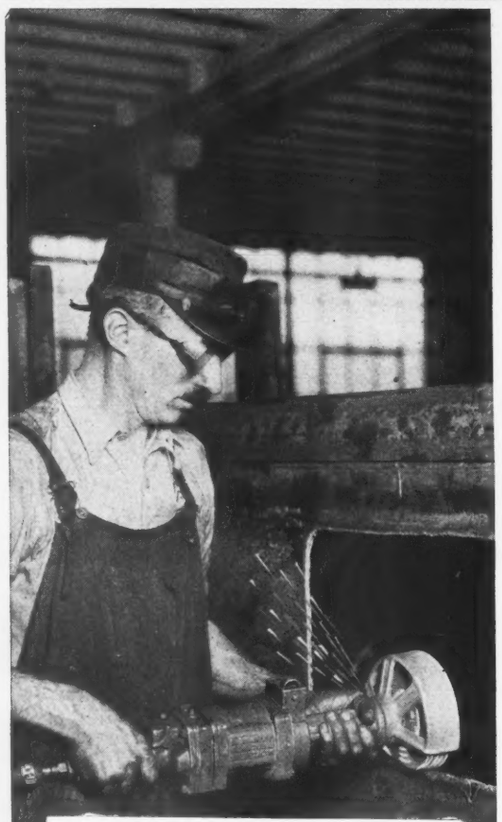


The Automatic Buffing Booklet shows interesting applications on a wide range of work. Send for it.

AUTOMATIC BUFFING MACHINE COMPANY

Chicago and Perry Streets, BUFFALO, N. Y.

Thor
ROTARY AIR GRINDERS



Sustained speed is maintained under all working conditions, which greatly increases production. Simplified construction results in lower maintenance costs and increases life of tool. Modern design plus a governor makes possible reduced air consumption.

These features, combined with Lighter Weight, Lack of Vibration, and Increased Power, make **THOR ROTARY AIR GRINDERS** the outstanding development in pneumatic tools. Write for descriptive literature.

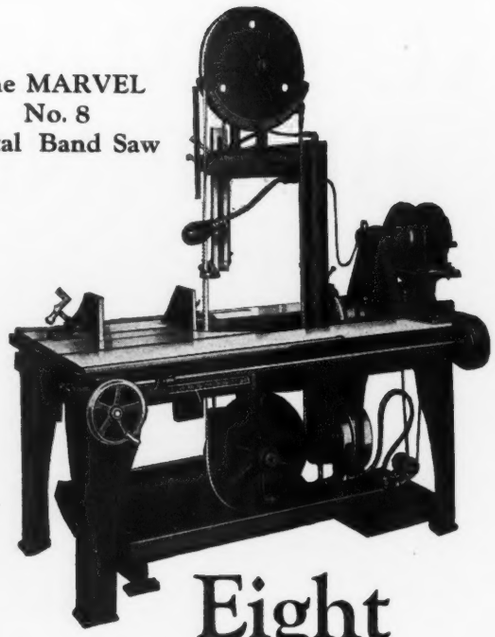
INDEPENDENT PNEUMATIC TOOL CO.

New York ..... TOOLMAKERS SINCE 1893 ..... London

PNEUMATIC TOOLS — ELECTRIC Thor TOOLS — AIR COMPRESSORS

606 W. Jackson Blvd. Chicago, Illinois

The MARVEL
No. 8
Metal Band Saw



Eight big features . .

1. 18-inch capacity.
2. Tilting Blade Frame—cuts off square or at any angle—right or left up to 45°.
3. Roomy bed and work table.
4. Three Cutting Speeds.
5. Large quick acting vise.
6. Ball bearing band wheels, carriage and guide rollers.
7. New feed that registers blade pressure in pounds.
8. Convenient electric light fixture attached.

In the foremost shops where speed, accuracy and economy of operation are essential, you'll find the Marvel Metal Band Saw No.8. The Marvel is especially efficient in the sawing of complicated dies, jigs and fixtures. And for peak production on channels, solid bars and beams it can't be beat.

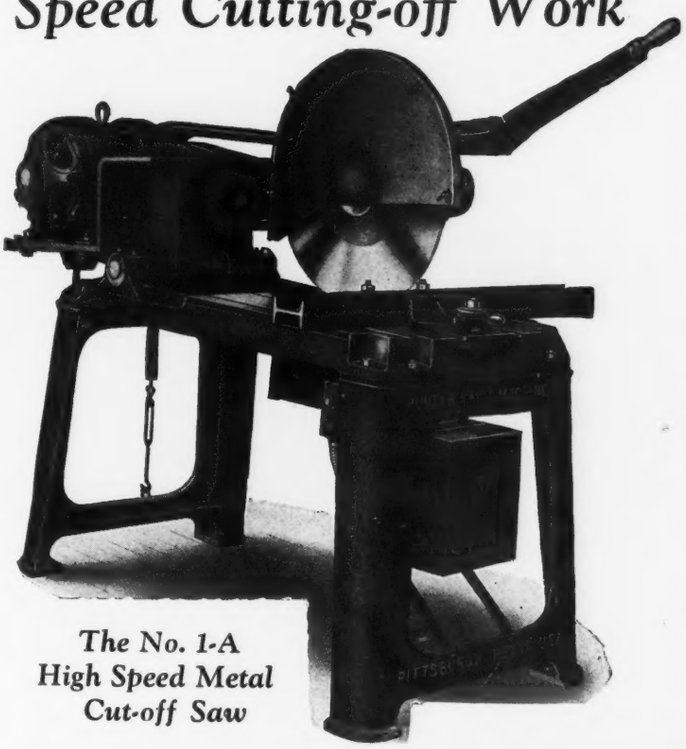
It will pay you to replace obsolete sawing equipment with the Marvel. Investigate and compare. Get *all* the facts about this versatile and economical saw. Write today for full details!

MARVEL

ARMSTRONG - BLUM MFG. CO.
343 N. Francisco Ave. Chicago, Ill.

HUNTER

. . . spells Profit on High Speed Cutting-off Work



The No. 1-A High Speed Metal Cut-off Saw

BECAUSE of its mechanical simplicity and sturdy construction, the operator can speed up production on the Hunter No. 1A without damage to the machine.

The Motor and saw blade are mounted on opposite ends of a tilted frame and balanced by adjustable spring tension. Saw arbor is mounted on a double row of deep grooved ball bearings, assuring freedom from friction and high speed. Bearings are protected in oil-tight, dust-proof housings, insuring longer life.

This saw is adaptable to a wide variety of work such as light section beams, channels, angles, brass, copper, structural and welded pipe, fire escape material, metal moulding, metal furniture parts, light sectional pressed and drawn steel shapes.

It will pay you to become thoroughly acquainted with the cost-saving advantages of Hunter equipment.

We also Manufacture

Inserted Tooth Saws, Circular Milling Saws, Pneumatic Hammer Rivet Sets, Chisel Blanks and Hardened Steel Specialties.

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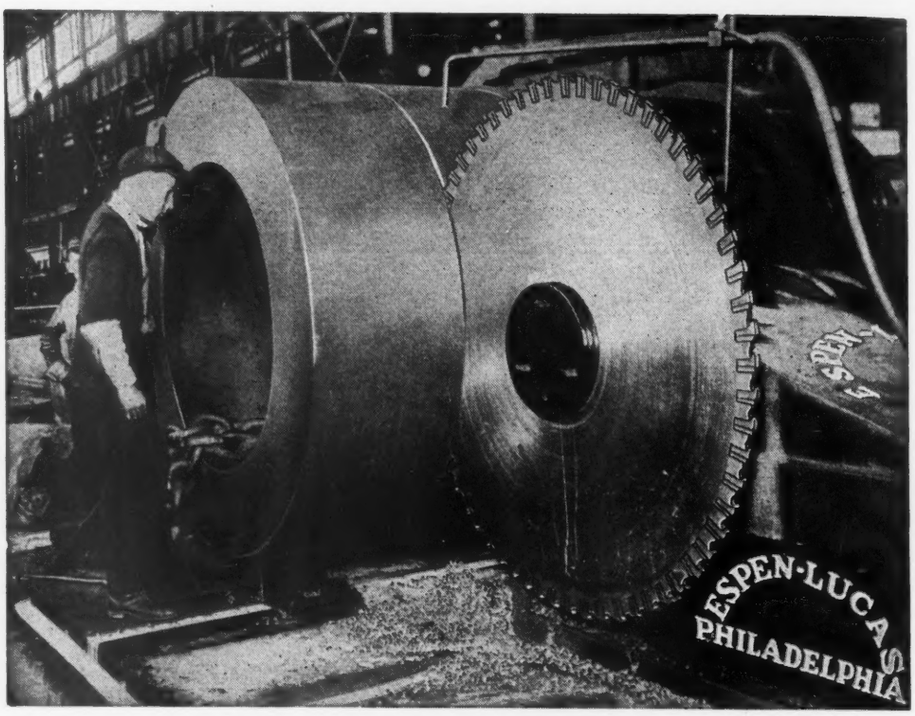
FAST AND ECONOMICAL SAWING

Tell us your needs, we have the knowledge, experience and will to correctly advise.

190 types and sizes of Sawing Machines for sawing all kinds of metal.



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Set these packs of Lenox Wolves on the trail of your toughest jobs!

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"The Tools in the Plaid Box"

AMERICAN SAW & MFG. COMPANY
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FORMERLY "YALE BRAND"

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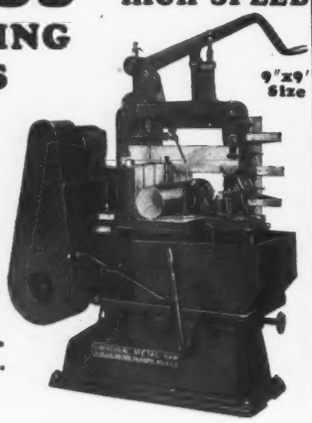
METAL SAWING MACHINES

UNIVERSAL HIGH SPEED

9"x9" size



Fast, accurate production Metal Sawing Machines for machine steels, tool steels, stainless steels and high speed steels as well as all other classes of cut-off work. Made in three sizes—6" x 6", 9" x 9", 13" x 13". Three Speeds. Belt or motor drive. Arrangements for motor, standard equipment.

"If it's a cut-off proposition—It's for PEERLESS"

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METAL CUTTING

There are Racine Machines for every metal cutting job.

The Shear Cut for Production Work.
The High Speed Saw for Regular Cutting.
The Band Saw for wood and metal.
The Abrasive Cutter for hardened steels.

Accuracy, speed and long life are inbuilt characteristics of this equipment. Write.

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PATENTED
Horizontal Boring Mills
Vertical Boring Mills
Slotters
Vertical Shapers

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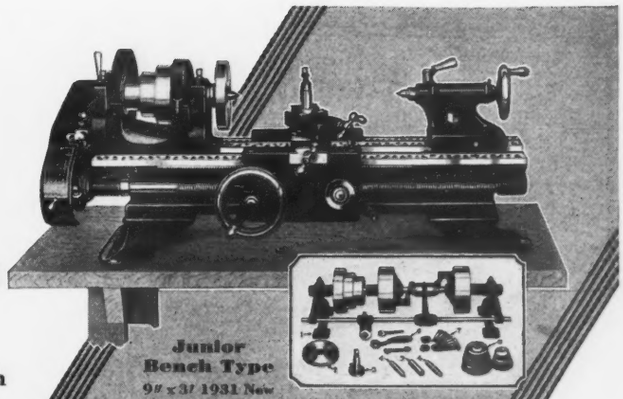
South Bend LATHES

New Models for 1931

$150 *and up.* For Manufacturing and Tool Room Work

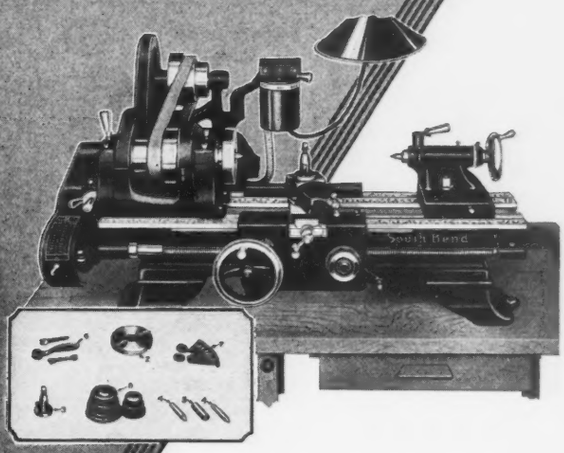
Ninety-six sizes and types of 1931 New Model South Bend Back-Geared, Screw Cutting Lathes are available from 9 in. Bench types shown here to 24 in. swing for large, heavy work. All are priced equally low ranging from $150 to $2,000. New improvements in Headstock, Apron and Carriage produce 25% more power with greater efficiency. The lathes shown here are especially suited to large scale production of small duplicate parts, fine tool and die work, experimental work and similar precise operations.



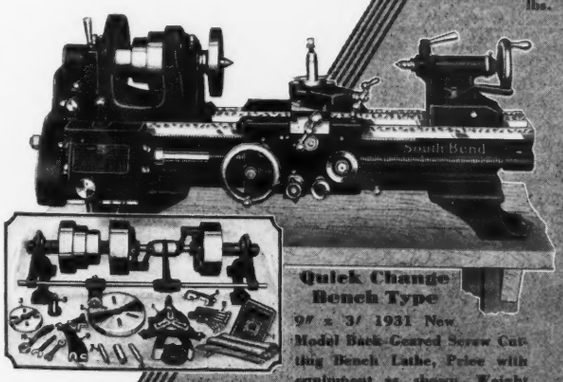
Junior Bench Type
9" x 3' 1931 New Model Back-Geared Screw Cutting Lathe. Price with equipment as shown. Weight 375 lbs. **$160.00**

Types Made

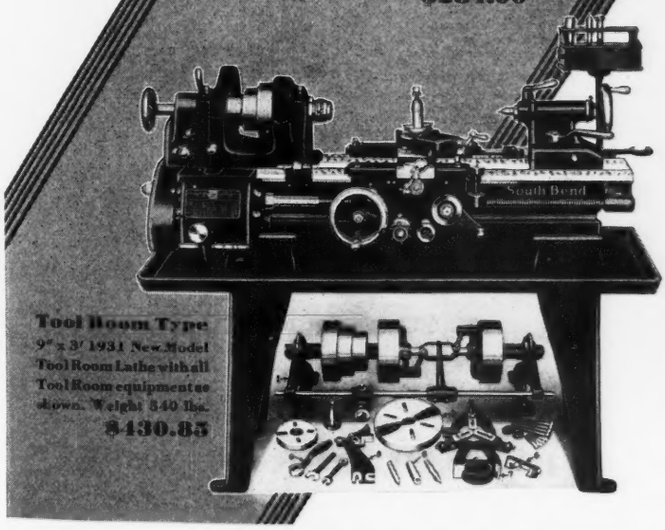
Quick Change Gear Lathes
Standard Change Gear Lathes
Tool Room Lathes
Gap Bed Lathes
Bench Lathes
Motor Driven Lathes
Countershaft Driven Lathes



Junior "V" Belt Motor Drive
9" x 3' 1931 New Model Back-Geared Screw Cutting Bench Lathe with "V" Belt Self Contained Motor Drive complete with motor, electrical and regular equipment. Weight 470 lbs. **$251.00**



Quick Change Bench Type
9" x 3' 1931 New Model Back-Geared Screw Cutting Bench Lathe. Price with equipment as shown. Weight 425 lbs. . **$284.00**



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9" x 3' 1931 New Model Tool Room Lathe with all Tool Room equipment as shown. Weight 840 lbs. **$430.85**

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Easy Payment Terms are available for the purchase of all sizes and types of New Model South Bend Lathes. Write for Easy Payment Booklet No. 91-P.

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—showing all 96 sizes and types of Back-Geared Screw Cutting Lathes for all classes of metal working where accuracy is required. This 104 page book is a valuable aid to every Superintendent, Master Mechanic and Purchasing Agent. Mailed postpaid free to any address. Use coupon below.

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726 E. Madison Street, South Bend, Indiana, U. S. A.

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(swing) (kind of work)

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THE No. 4 UNIVERSAL TURRET LATHE

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THE 3-INCH AUTOMATIC CUTTING OFF MACHINE

Embracing New Standards of Design and New Principles of Operation.
Let us mail you complete descriptive circulars.

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CLEVELAND, OHIO

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The M.C.E. Centrifugal Babbitting Machine will easily babbitt 40 connecting rods an hour, and the casting will be clean as a whistle—free from blow holes and impurities.

Save time and money the modern M.C.E. way. Machines available in 8", 12" and 18" sizes with built-in motors and cooling fans.

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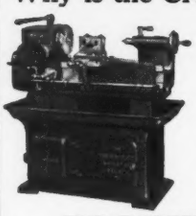

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2. Smooth worm gear drive gives chatterless finish at high speeds.
3. Timken and anti-friction bearings (18 in all).
4. Brute power.
5. Rigidity prevents tool breakage and allows successful use of new cutting alloys.
6. All features of a MODERN machine tool.

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are economical and accurate producers of screw machine parts up to 6" diameter, 7" milling length. They cut costs, increase production, boost profits. Write for particulars.

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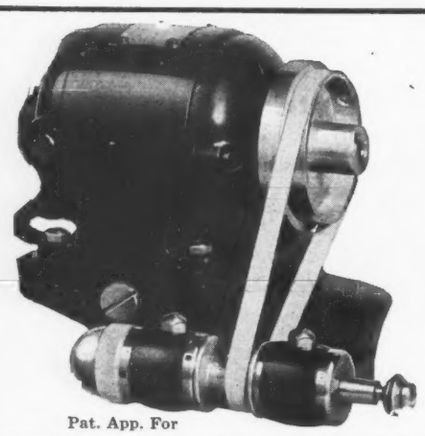
Pennsylvania: Arch Machinery Co., 1005 Park Bldg., Pittsburgh, Pa.
New York State: Syracuse Supply Co., Syracuse, N. Y., Rochester, N. Y.
Philadelphia, Pa.: Lloyd & Arms, Inc., 133 South 36th St.
New England: Potter & Johnston Machine Co., Pawtucket, R. I.
California: C. F. Bulotti Machinery Co., 829-831 Folsom St., San Francisco, Calif.



Pat. App. For

Grind Faster with the

***New* LAYTH-GRINDAR**

There's a lot of news awaiting users of grinding equipment! Our brand new circular on the new Engine "Layth-Grindar" is ready and you ought to have it. It shows the way to new speed, new economy and new efficiency on a wide range of grinding work. Tells how to cut grinding time in half.

Drop us a line if you're interested. The details are worth knowing.

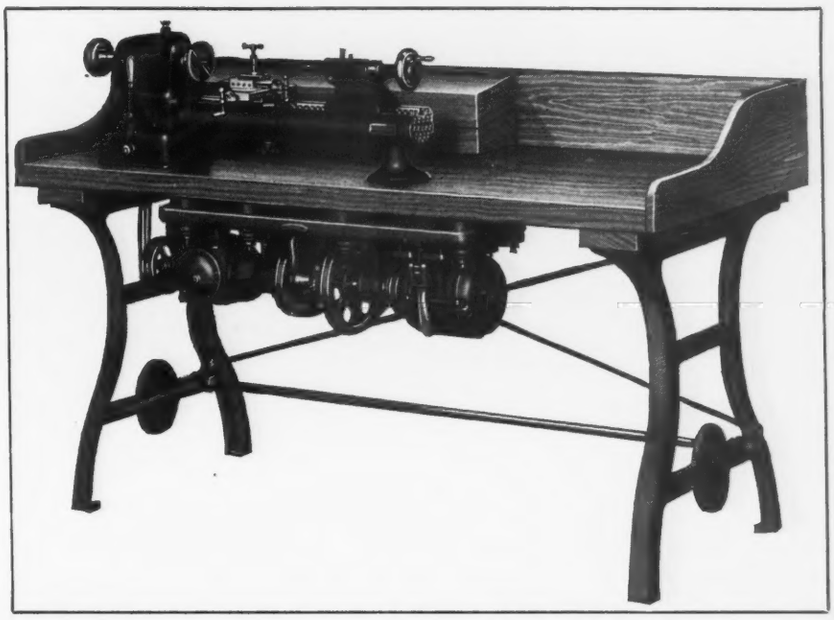
LAYTH-GRINDAR CORPORATION

28 Canfield Street **ORANGE, N. J.**

Cataract Motor Driven Bench Lathe Unit

Five sizes—from ½" collet capacity, 7" swing, to 1" collet capacity, 9" swing.

Six speeds ranging from 200 to 1700 RPM, both forward and reverse.



HARDINGE BROTHERS, INC., Chicago, Illinois, U. S. A.

Two Minute Set Up Multiple Tooth Cutters

DAVIS KEYSEATERS

combine two features that insure fast accurate keyseating in machines that give economical, enduring service.

Capacity 1/16" to 1" wide in hubs to 12" covers the most needed range. Davis Cutters in H. S. and Carbon Steels in sixteenths and some thirty-seconds. Send for details.

DAVIS KEYSEATER CO.
255 Mill Street, Rochester, N. Y.

FLATHER LATHES

Highest Grade for Tool-Room and Manufacturing Purposes

The Flather Co., Nashua, N. H.

LEBLOND

LATHES
TOOL ROOM
GRINDERS

THE
R.K. LEBLOND MACHINE TOOL CO.
CINCINNATI, OHIO

ETNA
ROTARY SWAGERS

REDUCE OPERATING COSTS

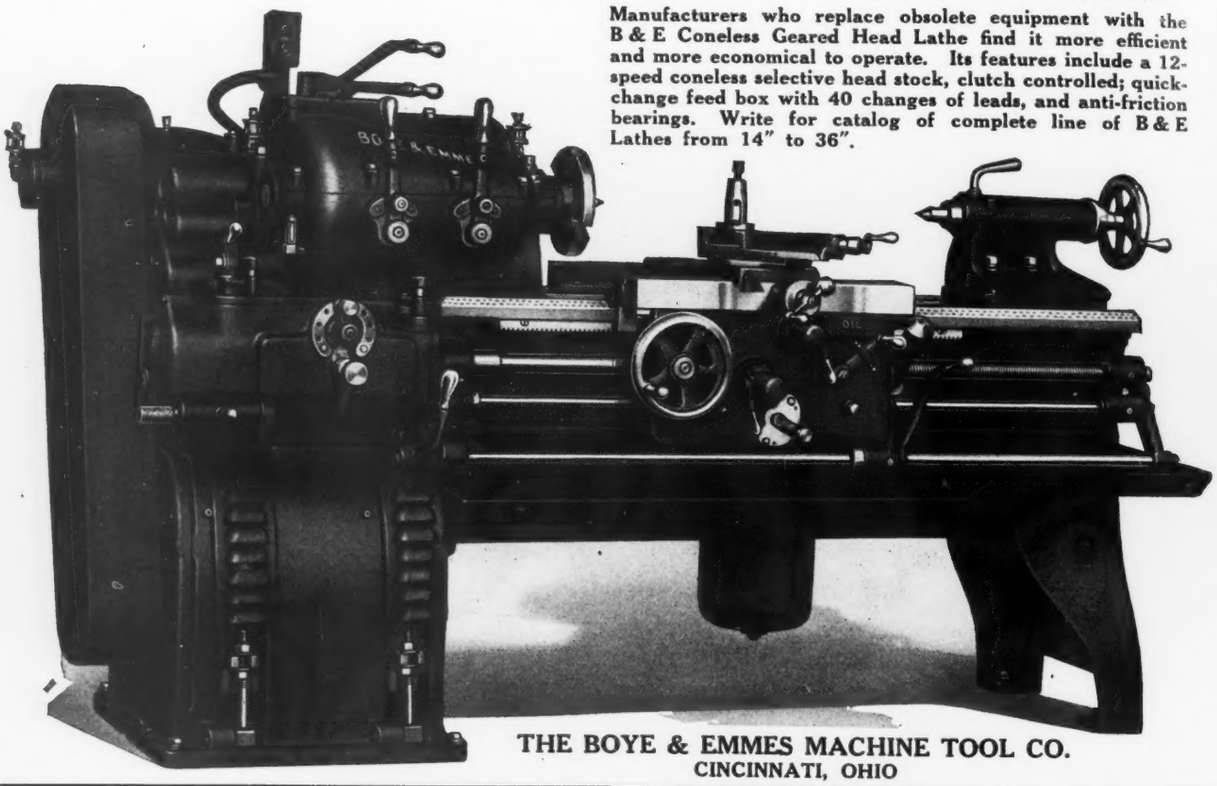
By INCREASING PRODUCTION in every plant where ETNAS are installed.

Late models are equipped with hydraulic feeding device and chuck. They size and taper steel rods to any given dimension in either hot or cold operations.

Etna Swagers are accurate. Write for estimates.

THE ETNA MACHINE CO.
TOLEDO, OHIO

A Lathe that is in Tune with Modern Ideas



Manufacturers who replace obsolete equipment with the B & E Coneless Geared Head Lathe find it more efficient and more economical to operate. Its features include a 12-speed coneless selective head stock, clutch controlled; quick-change feed box with 40 changes of leads, and anti-friction bearings. Write for catalog of complete line of B & E Lathes from 14" to 36".

THE BOYE & EMMES MACHINE TOOL CO.
CINCINNATI, OHIO

THE HIGH SPEED RIVETING HAMMER

(Patented)

Nine sizes for cold riveting, 1/64 to 1½ in. in diameter

Send riveting samples for demonstration
Write for Catalog "D"

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Over 1500 Machines in the U.S.A.

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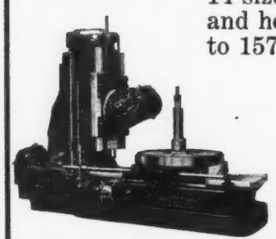
14 sizes for spur, worm, helical and herringbone gears, etc., up to 157" diameter—¾ D.P.



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Representatives for United States & Canada

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21 Park Row, New York, N. Y.

Shapers Exclusively

12", 14", 16", 20", 25"—Gear Box single pulley or motor drive, also 16", 20", 25" B.G. cone drive with belt shifter. 32" B.G. all geared single pulley or motor drive, all crank type "V" ram.

THE SMITH & MILLS COMPANY
CINCINNATI OHIO, U. S. A.

The Adams Gear Hobber and Thread Miller

An accurate, versatile and highly productive machine. Ask for circular.

THE ADAMS COMPANY 1905 Market Street Dubuque, Iowa, U.S.A.

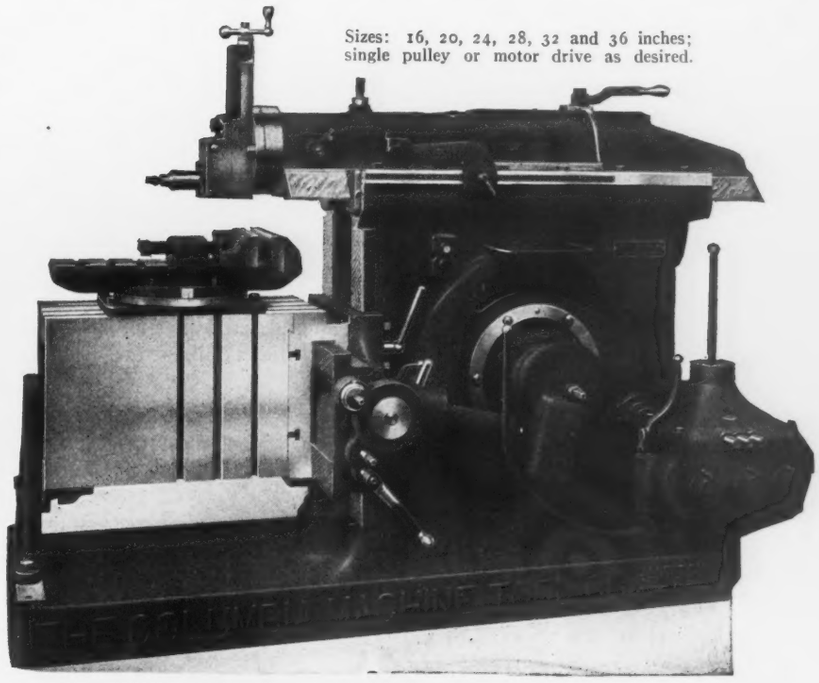
Shaping Costs Can Be Lowered!

Are you handicapped by shapers that are back numbers—badly worn, out of date, inefficient? Many shops are.

Let us show you what Columbia Superior Shapers can do on your work. More power, greater convenience, accuracy of alignment, insure increased output.

You owe it to yourself to get the facts on present-day shaping possibilities. Send for our new bulletin No. 18 giving specifications of all sizes.

THE COLUMBIA
MACHINE TOOL CO.
HAMILTON, OHIO, U. S. A.



Sizes: 16, 20, 24, 28, 32 and 36 inches; single pulley or motor drive as desired.

COLUMBIA SUPERIOR SHAPERS

A group of parts representing the wide range of application of these machines.

Diamond Tool Boring at its Best!

Coulter Automatics

are

Vertical Machines

Easy in operation
Minimum loading time
Quick in action
Accurate in results
Small floor space

There is a model available for all conditions and for holes in non-ferrous metals in diameters ⅜" to 12".

Bulletins and Estimates on Request

THE AUTOMATIC MACHINE CO., Bridgeport, Conn., U.S.A.

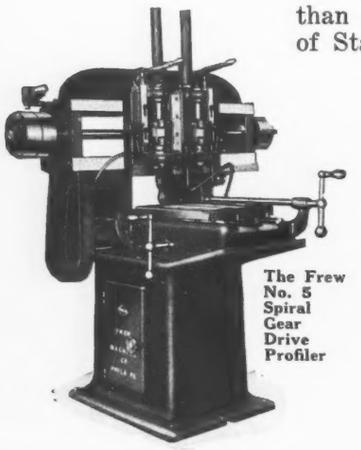
Special Purpose Machine Tools *by* FREW

The best standard machine tools came into existence by solving special problems. With this in mind we are concentrating part of our facilities on the designing of *special machine tools* for the solution of *your* special problems—whatever they may be.

Special Production Machinery

As a matter of interest, also, some of the products for which we have recently designed and built special production machinery are:—wooden battery separators—draftsmen's scales—textile shuttles—toys—cork products—paper products, etc.—a wide range.

And after all, could anything better qualify us to build Special Machinery, to solve difficult problems, than our experience as builders of the FREW Line of Standard Machine Tools?

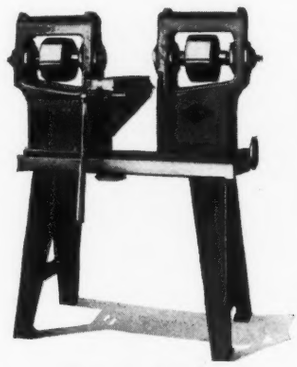


The Frew No. 5 Spiral Gear Drive Profiler

The FREW Line

Frew Motor Driven Hand Miller
Frew Duplex Hand Miller
Frew Steptoe Milling Machines
Frew Tapper
Frew Profiler
Frew Duplex Horizontal Drills
Frew Elliptic Chucks
Frew Vertical Grinders
Garvin Cam Cutters

THE FREW MACHINE CO.
132 W. Venango St., PHILADELPHIA, PA.



The new Frew No. 2 Duplex Hand Miller

Save space—save in equipment costs and get efficient shaper and slotter service in your tool room or shop with

THE RHODES SHAPER-SLOTTER

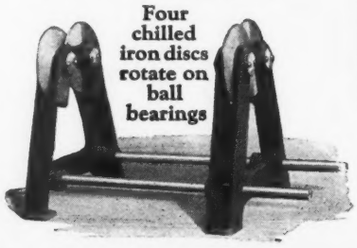
A combination machine easily convertible in a few minutes from a 7" capacity shaper to a 3½" capacity slotter. An efficiently built, carefully designed modern machine that gives efficient service.

Send for bulletin

The Rhodes Mfg. Co., Waltham, Mass., U.S.A.

Anderson Improved Balancing Ways

NO LEVELING REQUIRED



Four chilled iron discs rotate on ball bearings

They are made in the following sizes

Swing	Greatest Distance Between Standards	Capacity in Lbs.
20 in.	20 in.	1,000
40 "	30 "	2,000
60 "	30 "	2,000
72 "	66 "	5,000
96 "	88 "	10,000

A simple and excellent device for balancing, straightening and trueing.

Write for full information

ANDERSON BROS. MFG. CO., 1910 KISHWAUKEE STREET ROCKFORD ILLINOIS

CLEVELAND OPEN-SIDE

THE CLEVELAND PLANER CO.
3148 SUPERIOR AVE. CLEVELAND, O.

PLANAMILLING—PLANATHREADING

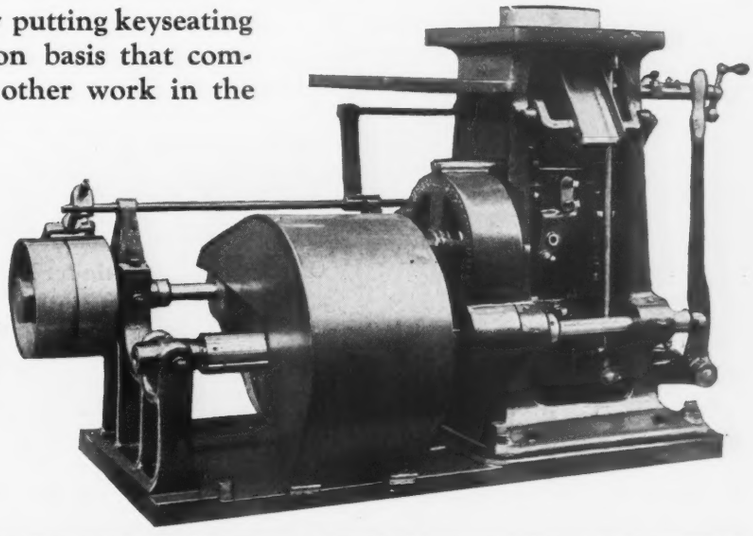
Production operations on the Hall Planetary Machine described *and illustrated* in "The Planetary—What It Is Doing". Send for it.

THE HALL PLANETARY CO.
Fox St. and Abbotsford Ave., Philadelphia, Pa.

The "GIANT" Pays Its Way

Cutting clean, accurate keyseats fast, is keyseating efficiency that makes **GIANT** installations popular everywhere. **GIANT** Keyseaters are simple and efficient in operation, have ample power to operate speedily and accurately and each of the eight sizes covers a wide and useful working range.

Every **GIANT** pays its way by putting keyseating on an efficiency production basis that compares favorably with the other work in the modern plant.



Keyseating is a routine job—there's plenty of it in every type of plant and it's easy to make it pay. Send for details of Giant Keyseaters.

MITTS & MERRILL

843 Water Street, Saginaw, Mich.

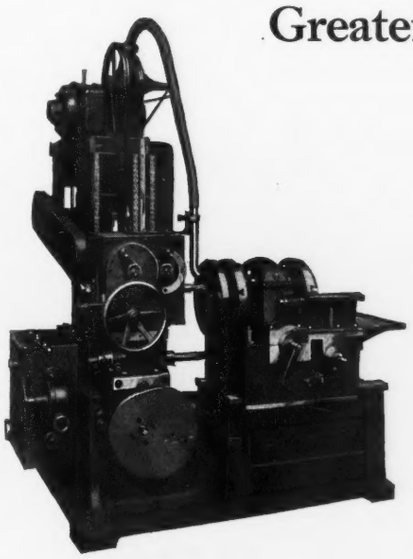
Builders of Machinery since 1854

FOREIGN AGENTS

Burton, Griffiths & Co., London, England. Aux Forges de Vulcain, Lyons and Paris, France. V. Lowener, Oslo, Norway and Stockholm, Sweden.

THE NEW ROWBOTTOM

Greater Adaptability—Greater Convenience for More Efficient Cam Production



This New No. 300 Rowbottom Cam Milling Machine is built on the former follower principle so successful in the old model Rowbottom with up-to-the-minute improvements that make for even more efficient, more economical cam production.

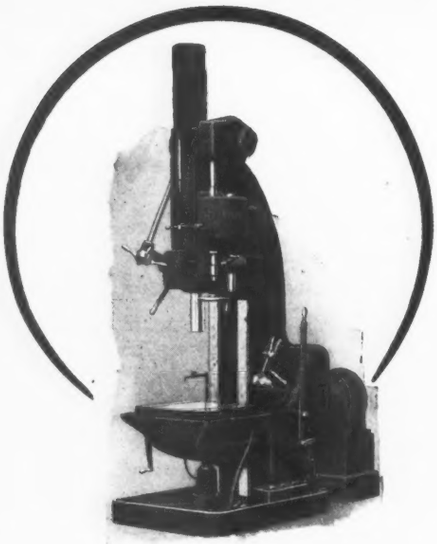
Capacity: box cams to 32" outside diameter; face cams to 28" diameter; barrel cams up to 24" diameter with 12" throw. Special fixtures make it possible to take cams of almost any size easily.

Cam users—cam manufacturers know the Rowbottom reputation. It will pay to investigate this new machine and its special features such as the combination milling and grinding feature, etc.

THE ROWBOTTOM MACHINE CO.

WATERBURY, CONN., U. S. A.

Rowbottom for Cams



POWER • SPEED • ACCURACY • ECONOMY

Essential characteristics combined in Defiance Drills by virtue of modern design and correct construction.

Every machine in the Defiance Line meets modern production and cost standards. The cut shows the Defiance Heavy Service Drilling Machine—made in four sizes.

Send for details of the Defiance Line—Horizontal Boring Mills, Cylinder Boring Machines, Heavy Service Drilling Machines, Rail Drills, Multiple Drilling Machines, Multiple Tapping Machines, Valve Grinding Machines.

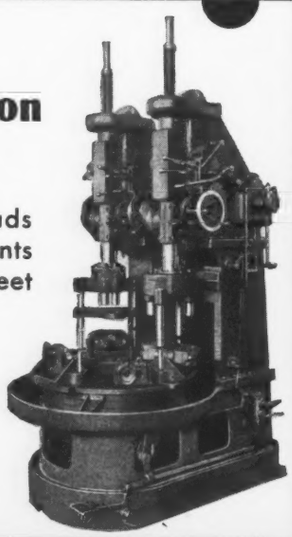
The Defiance Machine Works
Defiance, Ohio, U. S. A.
NEW YORK *Since 1850* LONDON

DEFIANCE DRILLS

Production Units

Our drill heads and attachments combined to meet your needs.

Send for details



• SELF-OILING ALL-GEARED •
Drilling and Cylinder Honing
for Quality in Quantity with Economy » Write for Catalog M
BARNES DRILL CO. 814 Chestnut St. Rockford, Illinois

The Elgin No. 0 Sensitive Drill

The ideal tool for drilling very small holes, long standard with jewelers and watch makers. Accurate and fast on pivot holes and similar jobs up to 1/16". Well made and smooth running. Spindle and bearings are hardened and ground tool steel. Ball bearing button and hand rest controls of feed. Stop collar regulator of depth. Furnished with No. 0 Jacobs Chuck. *Circulars on request.*

The **ELGIN TOOL WORKS, INC.**
Elgin, Illinois

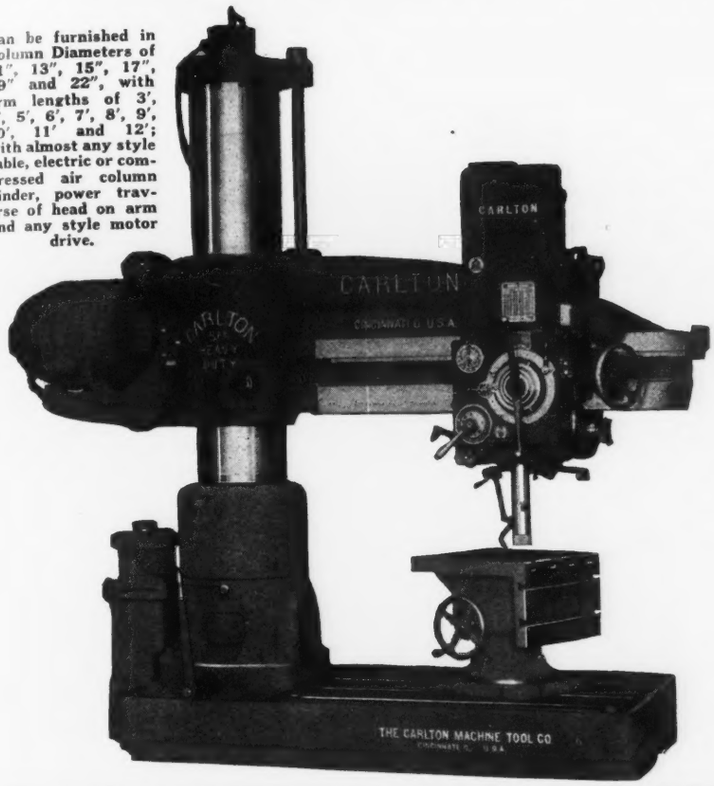
MILLHOLLAND METHOD *of* FLEXIBLE MANUFACTURE
⅛" Drill — Capacity, 12" Bore
***Profitably* Drill—Tap—Mill—Spot Face—Ream—Bore—Thread—Face with Millholland Units set up on standard machines or special bases. Send for details.**
MILLHOLLAND SALES & ENG. CO.
1833 Ludlow Avenue INDIANAPOLIS, IND.

"HOLE HOG"
Multiple Spindle Drillers, Borers, Counterborers, Reamers, Lappers, Tappers, and Universal Joint Machines
Particularly Designed for High Production Work
MOLINE TOOL CO., Moline, Ill.

CARLTON RADIALS

...fast!

Can be furnished in Column Diameters of 11", 13", 15", 17", 19" and 22", with arm lengths of 3', 4', 5', 6', 7', 8', 9', 10', 11' and 12'; with almost any style table, electric or compressed air column binder, power traverse of head on arm and any style motor drive.



There's no more logical installation than a Carlton Radial for high speed work. In the first place, it has speed in abundance, and in addition its rigid construction so eliminates vibration that close accuracy is consistent at all times. And that's always welcome!

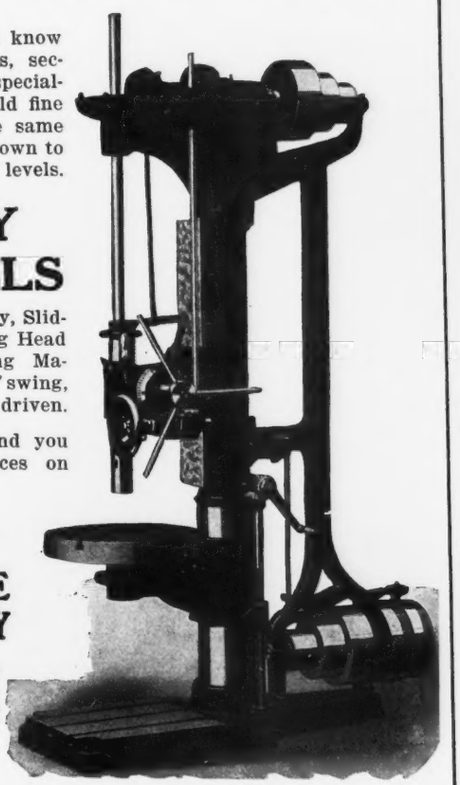
Equipped with ball bearings throughout.
Constructed on unit principle.
All steel gears running in oil.
Concentrated and convenient control.
Quiet running at all speeds.
Low hung drive to spindle.

Catalogs or estimates on request

THE CARLTON MACHINE TOOL CO.
CINCINNATI, OHIO, U. S. A.

Why We Specialize on Drills!

First because we know most about drills, second because by specializing we can build fine drills and at the same time keep costs down to surprisingly low levels.

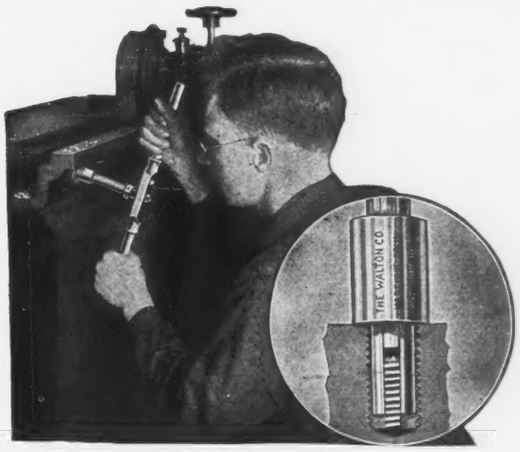


SIBLEY DRILLS

include Stationary, Sliding and Traveling Head Sensitive Drilling Machines 16" and 30" swing, belt or motor driven.

We'd like to send you details and prices on Sibley Drills.

SIBLEY MACHINE COMPANY
8 Tutt Street
SOUTHBEND
IND., U. S. A.



Here's the Cheapest Way to Extract a Tap

Invest the insignificant price of a Walton Tap Extractor in one of these handy tools and put an end to your extraction troubles. A Walton removes a broken tap almost as quickly as it takes to tell about it, *and saves the thread.* You can't do that with the hammer and chisel method; the Walton way is the modern way. Full details on request.

The Walton Company
310 Pearl Street **HARTFORD, CONN.**

Wickes Wall Radial Drill

Send for Bulletin RD-2

which describes this wall drill in complete detail

The Wickes No. 2 Heavy Duty Wall Radial Drill is very simple and rugged in construction and is designed especially for drilling holes through boiler plate or structural steel; also for countersinking, trepanning, enlarging punched holes, or for reaming holes accurately to size. It has a drilling capacity up to 1⅝", and a reaming capacity up to 2¼" in diameter. The drill is made for rigid attachment to column or wall, but may be arranged with power raising and lowering device, if preferred. The arms are made of heavy channels, planed top and bottom, and are well supported and braced. Arm lengths range from 10 to 18 feet. Get all the facts about this popular drill—write today.

Wickes Also Makes

Heavy Duty Engine Lathes, Special Production Lathes and Crankshaft Turning Equipment, Heavy Duty Plate and Structural Tools, Blue Print Machines

WICKES BROTHERS

Saginaw, Michigan, U. S. A.

75 Years of Manufacturing Progress

WICKES

Correct Speed for Any Hole

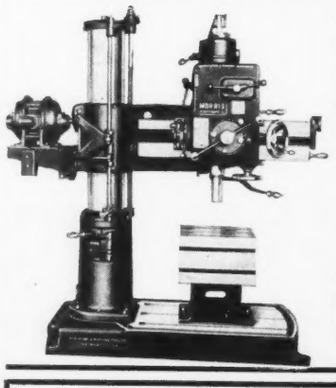
With capacity for holes to 3/16" diameter and speeds to 10,000 R.P.M., this Sigourney No. 0 Ball Bearing Sensitive Drill has correct speed for any hole in its range. Ball bearings throughout—modern construction insures smooth, fast operation and rigidity.

Send for details of the Sigourney Line of high speed precision drills

THE SIGOURNEY TOOL CO.

11 Sigourney St. Hartford, Conn.

Concentrated Control



Concentration of all controls in the head makes the Mor-Speed Radial fast and easy to operate. 27 speed changes (all in head) run in an oil bath, and among other features are hardened gears, broached keyways and Timken anti-friction bearings. Write for details!

The MORRIS Machine Tool Co.

CINCINNATI, OHIO

Sold by Pratt & Whitney Co. Agency Sales Dept.—Hartford, Conn.

SALES OFFICES IN: Birmingham, Boston, Chicago, San Francisco, Cincinnati, Cleveland, Detroit, Los Angeles, New York, Philadelphia, Pittsburgh, Rochester, St. Louis.

Make your drilling profitable with

HOEFER DRILLERS

Take advantage of the "minute-saving" features of Hoefer Drillers and Auxiliary Heads.

HOEFER MFG. CO., Freeport, Ill.

"SUPERIOR"

One word that fully characterizes the ability of Superior Drilling and Tapping Machines to render "SUPERIOR" drilling service. *Write for complete catalog.*

SUPERIOR MACHINE TOOL CO.

SUPERIOR

Kokomo, Indiana, U. S. A.

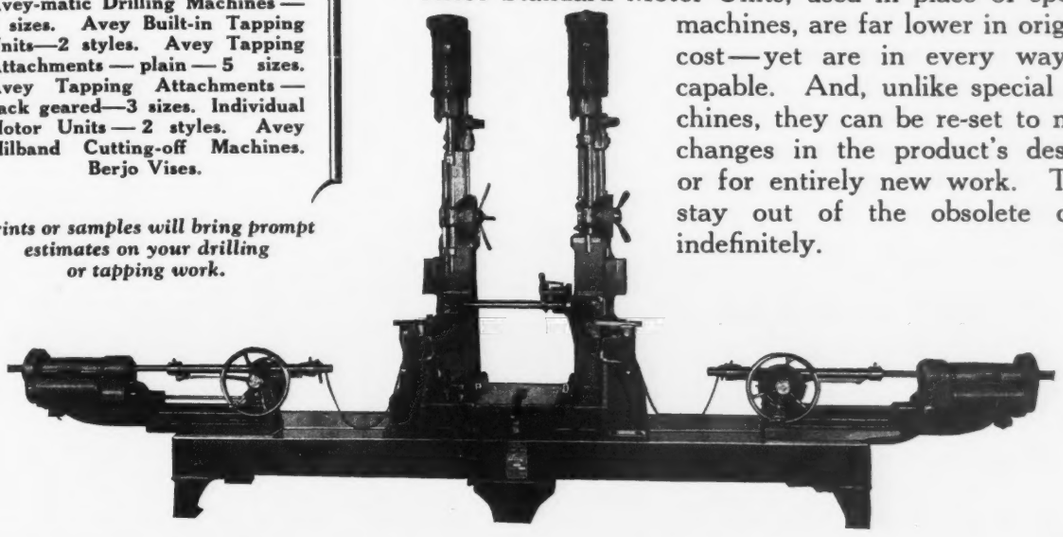
Drill More Economically the *Avey* Way

Avey Products

Avey Drilling Machines—5 sizes. Avey-matic Drilling Machines—3 sizes. Avey Built-in Tapping Units—2 styles. Avey Tapping Attachments — plain — 5 sizes. Avey Tapping Attachments — back geared—3 sizes. Individual Motor Units — 2 styles. Avey Milband Cutting-off Machines. Berjo Vises.

Prints or samples will bring prompt estimates on your drilling or tapping work.

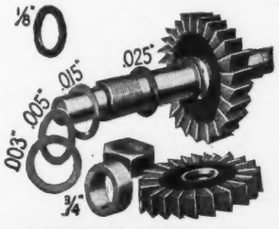
Avey has led the way to lower production costs on every type of high output drilling and tapping work. These Standard Motor Units, used in place of special machines, are far lower in original cost—yet are in every way as capable. And, unlike special machines, they can be re-set to meet changes in the product's design, or for entirely new work. They stay out of the obsolete class indefinitely.



THE AVEY DRILLING MACHINE CO., Inc., Cincinnati, O.

Steel Spacing Washers

Send for free samples in the sizes you use most. Stock sizes for arbors of the following diameters:



⅜, ½, ⅝, ¾, ⅞, 1, 1⅛, 1¼, 1⅜, 1½, 1⅝, 1¾, 1⅞, 2, 2¼, 2½, 2¾, 3, 3½ and 4 inches and larger.

Stock Thickness: .001, .002, .003, .004, .005, .006, .007, .008, .010, .012, .015, .020, .025, .032, .047, .063, .093, and .125 inch.

Spacers thicker than ⅛" are turned from tubing or bars but not carried in stock.

DETROIT STAMPING CO.
3445-3459 West Fort St. DETROIT, MICH.

RYERSON MACHINE TOOLS

OHIO HORIZONTAL BORING DRILLING AND MILLING MACHINES

MONOTROL AND TRITROL LATHES — MAXIMILLER S DRESES RADIAL DRILLS — OHIO SHAPERS AND PLANERS

WRITE FOR CATALOG — JOSEPH T. RYERSON & SON, INC., CHICAGO

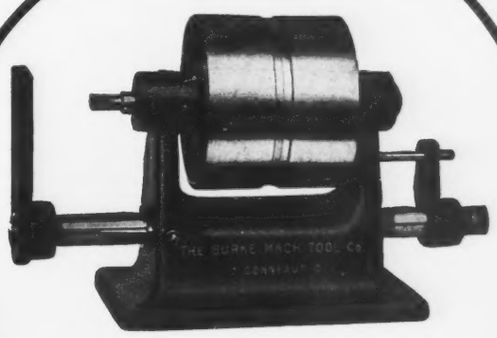
U. S. HAND MILLERS
For all classes of light milling

U. S. SENSITIVE DRILLERS
For all classes of light drilling

Send for Circulars and Prices

UNITED STATES MACHINE TOOL CO. CINCINNATI OHIO

BURKE



—for good tapping

Here's the machine to make your light tapping work really profitable. It is fast, accurate and economical, both in original and operating cost. Entirely automatic, except for insertion and removal of work, and dependable as the seasons; never breaks a tap or strips a thread. Use it too for reaming, burring, countersinking; it's a money maker on each. Circulars on request.

THE BURKE MACHINE TOOL CO.
516 Sandusky Street, CONNEAUT, OHIO, U. S. A.

Check Your Drilling and Boring Costs

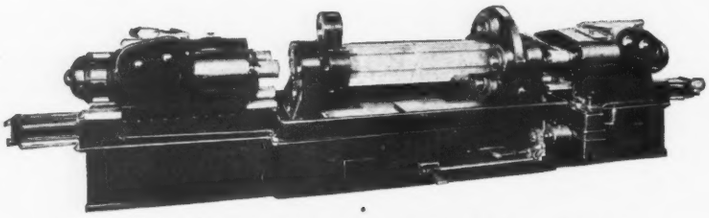
THE ROCKFORD DRILLING MACHINE Co. · ROCKFORD · ILL., U.S.A.

If you drill, bore or tap at production speeds in any metal, there is Rockford equipment available that can produce special machine results without the usual penalties of cost.

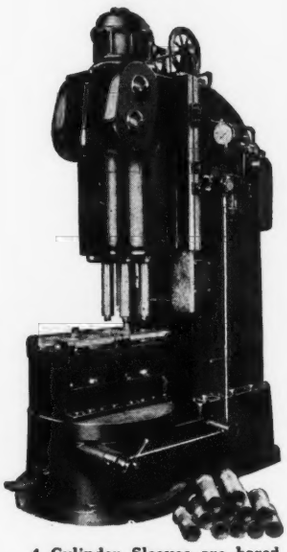
Interchangeable spindle units eliminate the risks of obsolescence; set-ups can be dismantled and re-assembled for varying kinds of work. Construction features are many; to name just a few: Oilgear Feeds, Timken Tapered Roller Bearings, Direct Motor Drives through Worm, and Worm Gear Reduction.

Your layouts and details of production requirements will bring interesting recommendations from our Engineering Department, without obligation. Write today.

ROCKFORD DRILLING MACHINE CO.
209 Catherine St. ROCKFORD, ILL.



With this machine, each index of the Four-Sided Drum Table produces a large Rear Axle Housing with both ends Rough Bored, Semi-Finish Bored and Finish Bored.



4 Cylinder Sleeves are bored simultaneously while 4 more are loaded on Indexing Table. Complete Automatic Cycle of head.

The LESTER Die Casting Machine

HYDRAULICALLY OPERATED

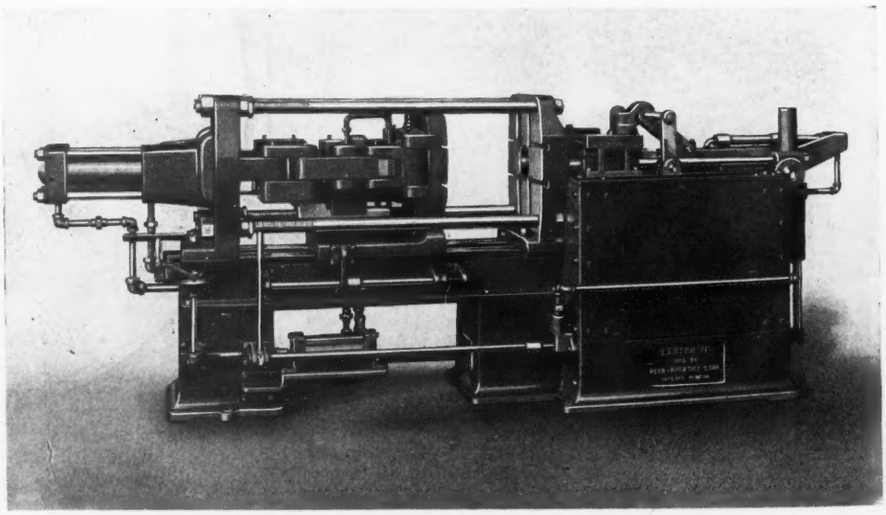
Die Castings with
SAFETY, ACCURACY
and SPEED

Production 25% - 40% greater than previous types.

Over 300 LESTER Die Casting Machines are already in use by electrical and household utility manufacturers.

Built by one of the foremost machine tool plants insures correct design, accuracy and workmanship. Automatically operated hydraulic cylinder can be supplied for ejecting casting from the die while automatic removal of cores during opening stroke can also be furnished.

Send us your inquiries with samples or prints for proposal on complete installation.



Manufacturers and Selling Agents

REED-PRENTICE CORP., Worcester, Mass. NEW YORK—41 Broad St. DETROIT—6-246 Gen. Motors Bldg.

Die and Engineering Service

LESTER DIE AND MACHINE CO., 2810 Superior Ave. cor. East 30th St.
Cleveland, Ohio

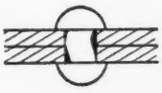
MARQ

RIVETING MACHINE

WITH OVERLOAD SAFETY BED

The safety bed yields when parts or rivets are oversize, preventing breakage — and provides sufficient pressure to eliminate loose rivets where parts are undersize.

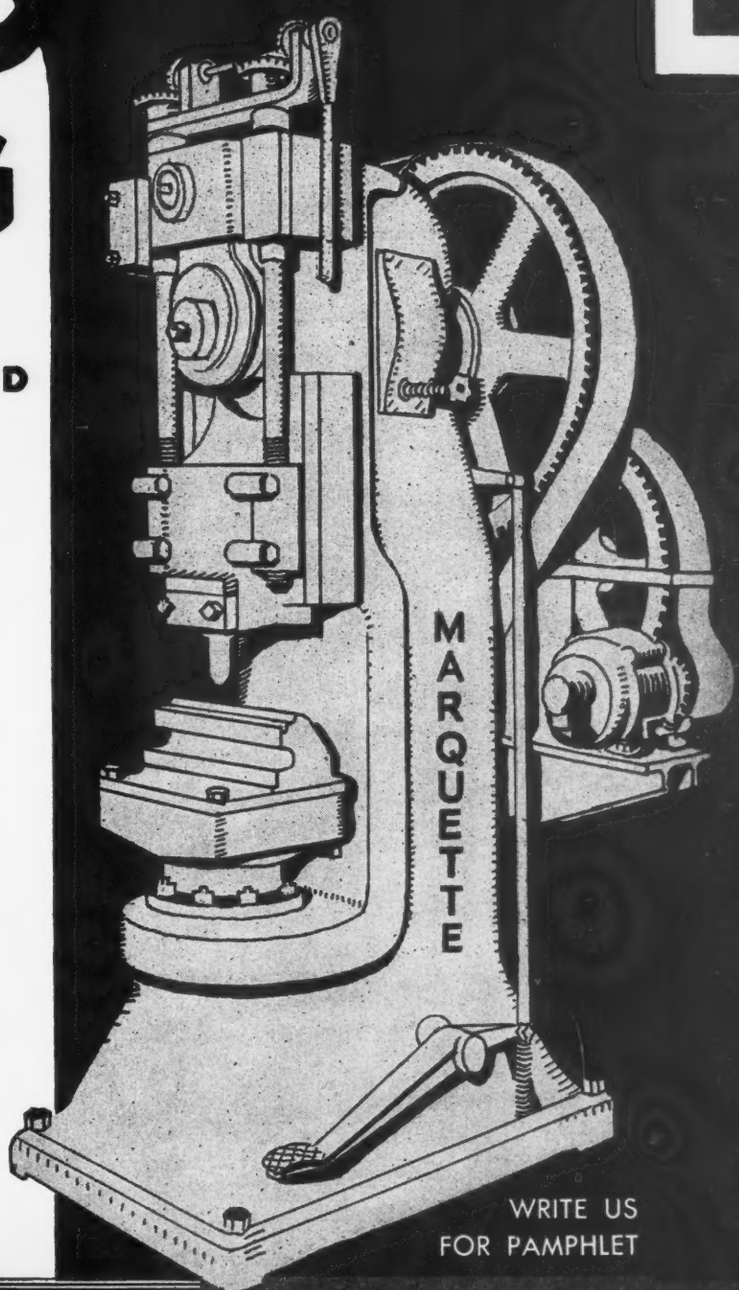
NO MORE SMASHED RIVETS

NO MORE  LOOSE RIVETS

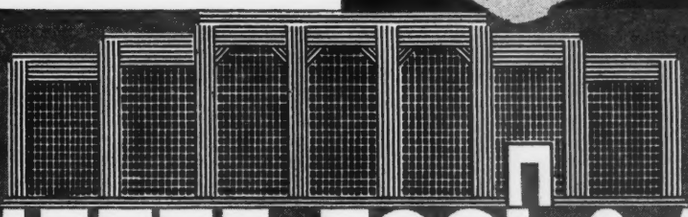
The MARQUETTE SAFETY BED built into this press yieldingly exerts the correct pressure for any size rivet.

Perfect embossing or coining work can be done where parts vary in thickness.

This MARQUETTE BED insures proper pressure and prevents breakage.



WRITE US FOR PAMPHLET



MARQUETTE TOOL & MFG. CO.

6500 WEST 65TH STREET » CHICAGO » U. S. A.

MARQUETTE CUSHIONED PRESS BEDS

MEAN CORRECT BLANKHOLDING PRESSURES

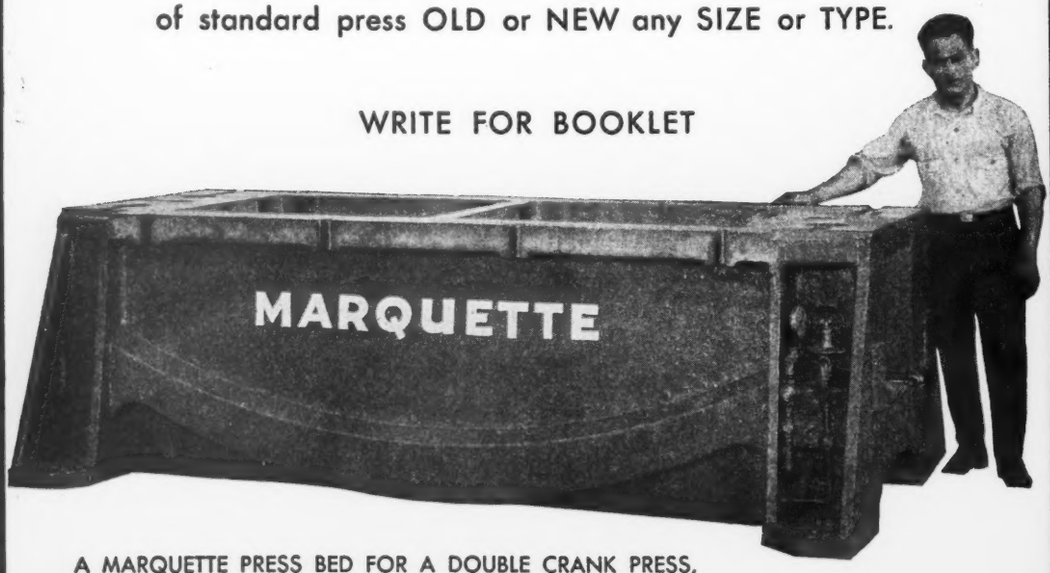
SMOOTHER STAMPINGS—LESS SPOILAGE

Deep and costly foundation pits are eliminated by building the cushions right into the bed making it possible to move presses to suit production requirements.

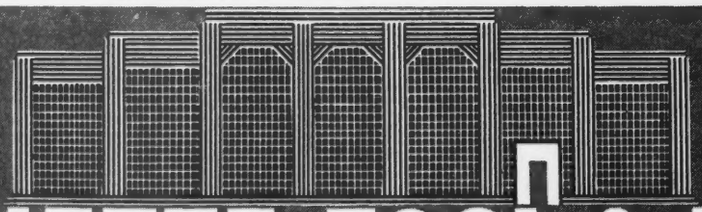
Only one pipe connection is necessary, which eliminates installation expenses.

MARQUETTE PRESS BEDS are built for any make of standard press OLD or NEW any SIZE or TYPE.

WRITE FOR BOOKLET



A MARQUETTE PRESS BED FOR A DOUBLE CRANK PRESS, FOR A GREAT VARIETY OF METAL DRAWING WORK



MARQUETTE TOOL & MFG. CO.

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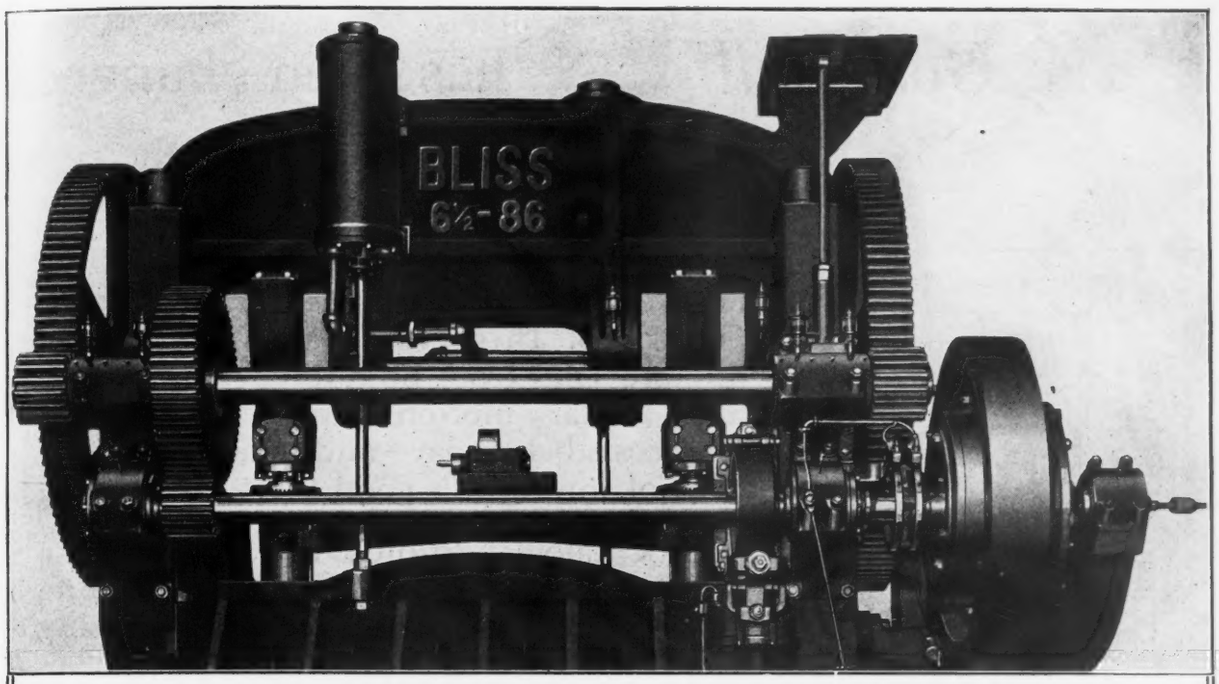

SIMPLIFIED MULTIPLE SAFETY CONTROL

BLISS MULTIPLE DISC FRICTION CLUTCH

WITH MAGNETIC CLUTCH AND BRAKE CONTROL

COMPACT - POWERFUL - SENSITIVE

The BLISS Automatic Multiple Disc Friction Clutch with Magnetic Clutch and Brake Control meets the requirements of modern safety engineering in the simplest way. It is the first radical departure from the old single disc Friction Clutch with Magnetic Control.

The push-button system operates the clutch and the brake through an electrical controller. There is none of the mechanical clutch shifting gear. The only place about the clutch to lubricate is the Timken flywheel bearing.

The clutch proper is our standard multiple disc design which, *with its single screw adjustment,* has shown its quality in thousands of installations.

A small drum controller in a locked compartment gives easy selection of either automatic top stop, continuous running, or inching operation.

Any desired number of push-button stations may be supplied.

BLISS

E. W. BLISS CO. MAIN OFFICE AND WORKS BROOKLYN, N. Y., U. S. A.

Sales Offices

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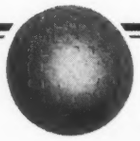
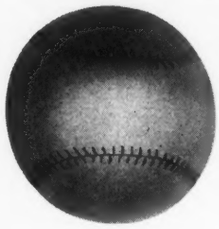
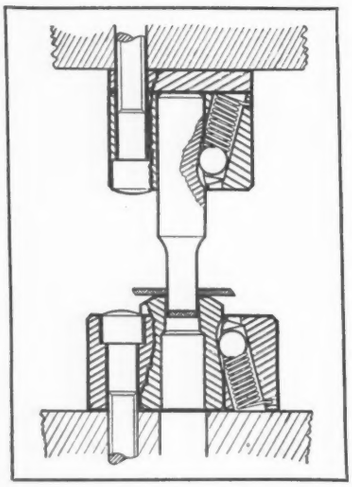
American Factories: BROOKLYN, N. Y. HASTINGS, MICH. - SALEM, OHIO

The *Golf Ball*  has been changed

—and so has the *Baseball*



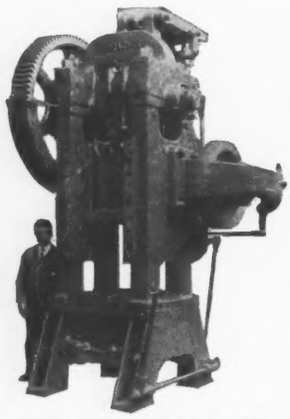


But the ball that securely holds the Richard Bros. Interchangeable Punches and Dies from both longitudinal and rotary motion is still reducing press operation costs below par—and what a whale of a number of innings it's good for!

Write for Catalog, Edition BB. It contains a complete line of Die Makers' Supplies, including Die Sets, Die Sections, Pins, Bushings, Spring Pilots, Springs, Screws, Dowels, Punches, Dies and Retainers.

ALLIED PRODUCTS CORPORATION, RICHARD BROTHERS DIVISION
1560 East Milwaukee Avenue, DETROIT, MICHIGAN

FERRACUTE
Single Crank Presses



125 Ton Press DGGF—56½

FERRACUTE Single Crank presses are very versatile. They are designed to stand heavy and continuous work. They are so built as to be easily adaptable for all kinds of operations.

We would like to have you become better acquainted with our whole line of presses and dies. We feel sure that we have the proper press to assist you in reducing your costs.

We would be glad to send you our latest catalog if you will write us.

FERRACUTE MACHINE CO.
BRIDGETON, N. J.
Detroit Office—817 Donovan Bldg., 2457 Woodland Ave.

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GREENERD ARBOR PRESSES

Capacities of 15 Lbs. to 40 Tons

Write for catalog showing 64 styles

EDWIN E. BARTLETT CO.
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ROBINSON SHEET METAL WORKING MACHINERY

Inclinable Presses — Gap Presses
Double Crank Presses — Squaring Shears
Horning Presses — Gap Shears
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Hand and Power Brakes

NEW ALBANY MACHINE MFG. CO.
NEW ALBANY, IND.
Exclusive Mfrs. of The L. M. Robinson Mfg. Co. Products

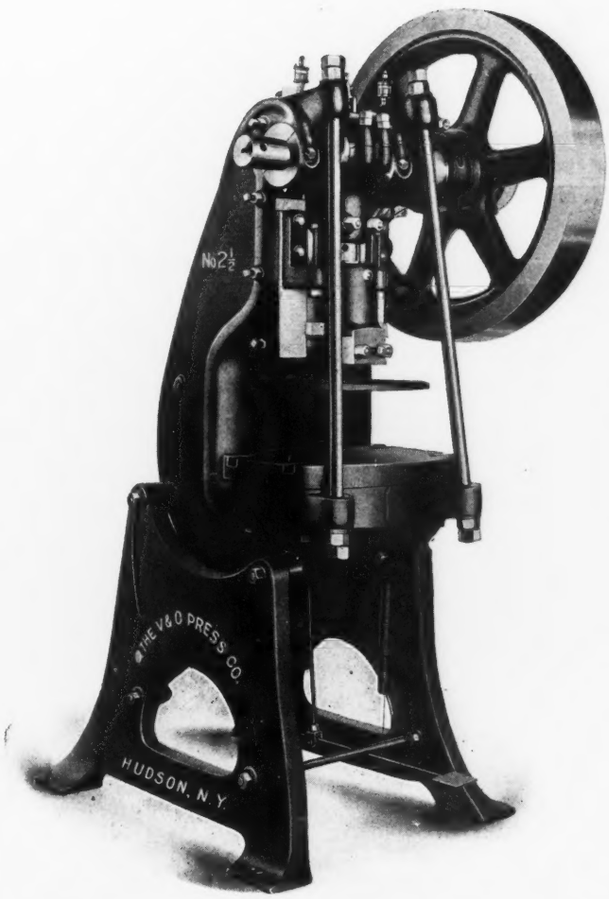
MINSTER POWER PRESSES

INCLINABLE—HORNING—STRAIGHT SIDE
KNUCKLE JOINT-GAP AND SCREW PRESSES

The MINSTER MACHINE CO. Minster, Ohio, U.S.A.

Another Reason for V&O Efficiency

—an eccentric instead of a crank



In V & O "Long Slide" presses the eccentric type shaft is used in all strokes up to the limit of clearance and practicability. This places maximum strength at the center, where it is needed, and eliminates any tendency to spring or bend on heavy work—a fault common to crank type shafts. As a result, more speed, power and accuracy are developed—more work produced at far less cost per part.

This is typical V & O designing; similar outstanding features are present in every detail of the machine's construction. Get all the facts of this modern line, as presented in our booklet, "Power Presses." Your request brings it without obligation.

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HUDSON, N. Y.

Philadelphia Office: Bourse Bldg.

Cleveland Office: 2023 Elmwood Ave. Lakewood, Ohio

Chicago Office: 549 W. Washington Blvd.

Henry Prentiss & Company, New York, Boston, Hartford, Syracuse, Rochester, Buffalo.

Hooven, Owens, Rentschler Co., Detroit, Michigan

V&O "Long Slide" PRESSES

WALTHAM
TRADE MARK
REGISTERED U.S. PAT. OFF.

A Sub-Press of Unique Design for Maximum Precision on Small, Complicated Punchings

Waltham Overhang Sub-Presses are especially adapted for the production of small, delicate or highly irregular punchings. Their unique cylindrical design provides maximum precision and rigidity for this kind of work.

Waltham presses have unusual clearance in front, and a rear opening to furnish ample space and light in locating parts for second or third operations. They are exceptionally economical for blanking—with or without roll feed. Stock models may be had with plungers $1\frac{3}{16}$" to 6"—special sizes on short notice.

Write for a new folder on Waltham Cylindrical Sub-Presses.

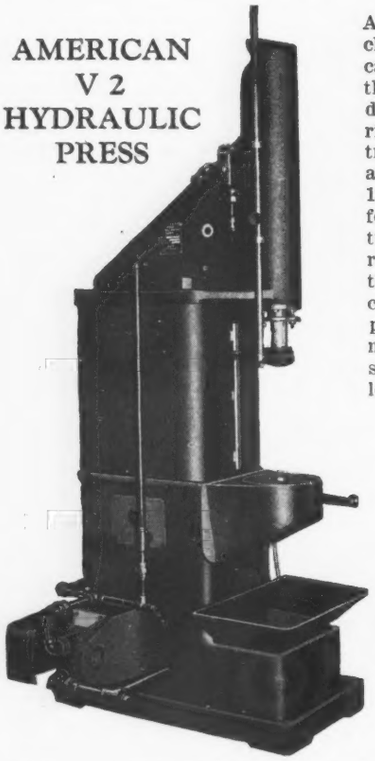
WALTHAM MACHINE WORKS

Newton Street, WALTHAM, MASS.

Makers of Small Thread Millers, Gear Cutters, and other Small Automatic Machines

AMERICAN POWER PRESSES

AMERICAN V 2 HYDRAULIC PRESS



A modern line of machines from 2 to 50 tons capacity. The cut shows the American V-2 Hydraulic Press—solid, rigid, massive, with extra wide throat and 21 and 27 inch stroke, 6 to 12 ton sizes. Hydraulic feed with automatic return of ram to top on release of levers; optional flexible operating controls which permit pressure from 0 to maximum by a simple pressure of the operating lever.

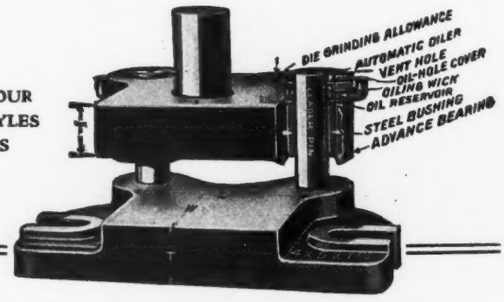
And this is only *one* number in an important line. Send for details of American Power Presses.

AMERICAN BROACH & MACHINE CO.

Ann Arbor - Michigan

Builders of All Types of Broaching Machines and Broaching Tools.

ONE OF OUR MANY STYLES AND SIZES



Baumbach Standard Automatic Oiled DIE SETS

Made of 25% Steel

Get our new 120 page Die Set Guide listing 70,000 Sizes. Select your own Standard

Baumbach Die Sets built this Modern Plant

E. A. BAUMBACH MFG. CO.

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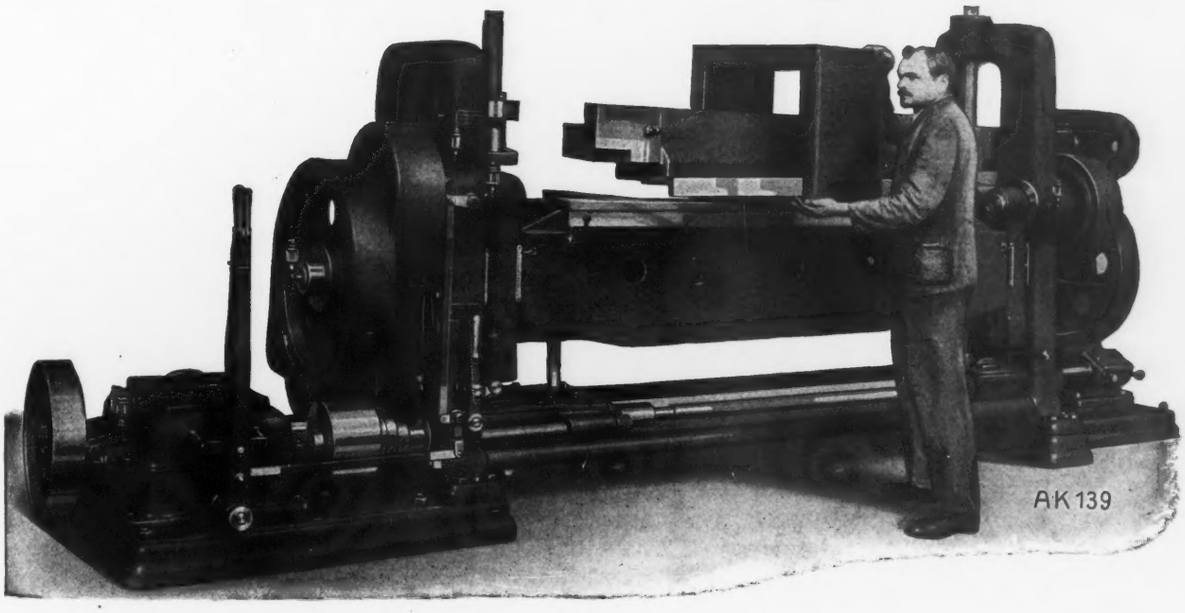
Sales and Engineering Offices in principal cities U. S. A. and Canada

SCHATZ

Universal - Brake, Rounding and Box Forming Machine.



The Most Versatile Plate Bending and Forming Machine Available!

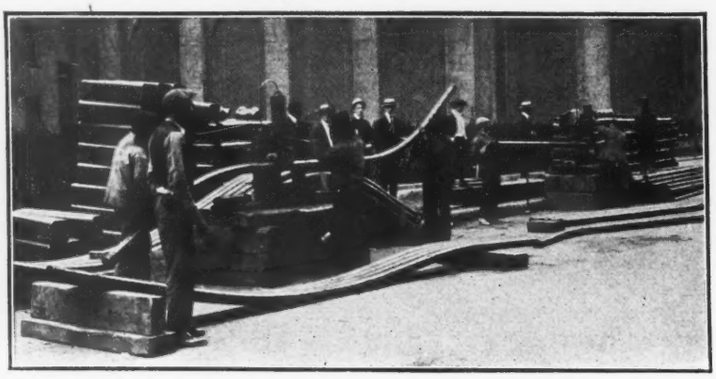
For Forming Boxes, Cases, Rectangular Tanks, etc., from one sheet of material.
Chutes and Troughs of all descriptions.
Trays and Boxes with high sides.
Perfect Tubes and Pipe, Straight or Tapered, up to 23-in. diameter.
Sharp Bends or Round Bends up to Large Radius.
Machines have unusually Wide Openings Between the Bars.
Accuracy of Bends and Parallelism of Bars Guaranteed.

Ask for Illustrated Form 129.

Made in 60 sizes, hand or power drive.

THE SCHATZ MANUFACTURING CO.
POUGHKEEPSIE, N.Y.

"UNUSUAL MACHINE TOOLS"



Watson-Stillman Hydraulic Benders Bending Conduit Pipe for Subway Work. Note that but three men are needed in each crew.

Rapid Pipe Bending with a Watson-Stillman Bender

This contractor and many others are realizing the saving in cost and time in doing their bending on the spot as required.

The illustration shows two of our hydraulic pipe benders designed for bending pipe of various sizes. These machines are not only rapid and economical of labor, but the bends are made uniform and without danger of buckling or crushing.

We build complete hydraulic plants, including pipe, valves, pumps, accumulators, intensifiers, and presses for every purpose such as:

FORGING
FORMING
FORCING
DEHYDRATING
THERMO PLASTIC MOLDING
BLOCKING AND EXTRUDING
BRIQUETTING
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BENDING
CLAY FORMING
SAGGER MOLDING
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COCOA BUTTER EXTRACTING
COMPRESSING AND FORMING, ETC.

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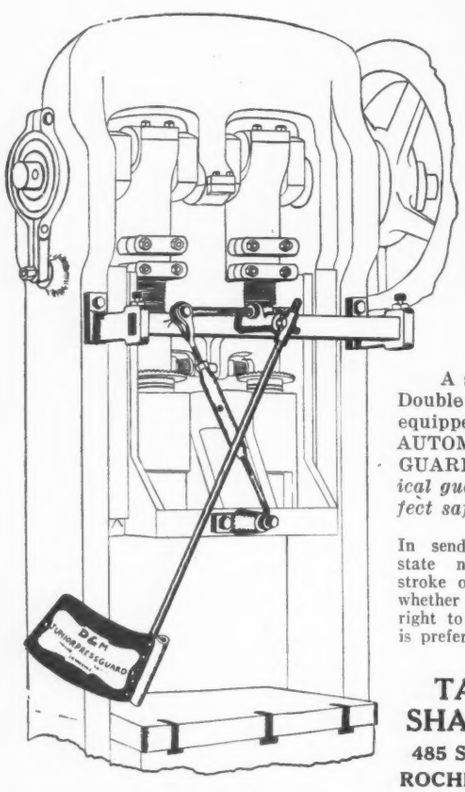
THE WATSON-STILLMAN CO., 107 Aldene Rd., Roselle, N. J.

75 West St., New York, Chicago, Philadelphia, Pittsburgh, Detroit, St. Louis, Cleveland, Cincinnati, St. Paul, Seattle, Denver, Portland, San Francisco, Los Angeles, Houston, Atlanta, Birmingham, Richmond, Tulsa.

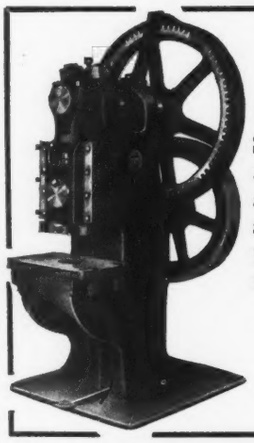


SAFETY

A straight Sided Double Crank Press equipped with a D&M AUTOMATIC PRESS GUARD—*an economical guarantee of perfect safety.*

In sending for details, state name, size and stroke of press and tell whether left to right or right to left hand swing is preferred.

TAYLOR-SHANTZ CO.
485 St. Paul Street
ROCHESTER, N. Y.



"ADRIANCE" *Punch Presses*

Sturdy tie-rod construction assures long life for press and tools, with expedition and accuracy of performance in punching, bending, forming and perforating operations.

ADRIANCE MACHINE WORKS
INCORPORATED
78 Richards St., Brooklyn, N. Y.

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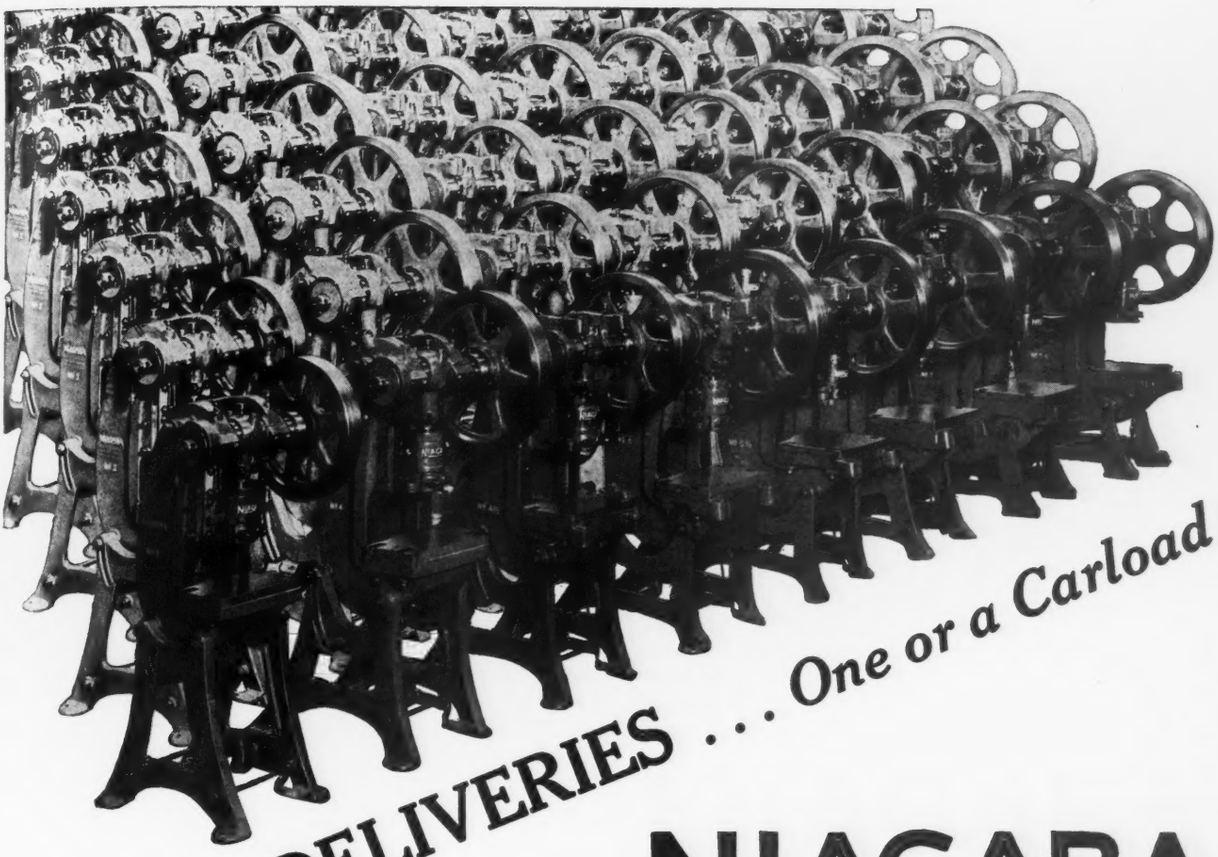

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NIAGARA

Inclinable Presses

LONG LIFE

Massive frames in Niagara Inclinable Presses give rigidity and strength. Bearing surface of frame absorbs all upward shaft stresses.

TROUBLE-FREE SERVICE

All equipped with Niagara clutch and patented tripping mechanism which has fewer parts of more rugged construction.

Used for METAL STAMPING . . CUTTING . . DRAWING . . FORMING . . PERFORATING . . BENDING . . COMBINATION DIE WORK

WHATEVER your inclinable press requirements are, you can depend upon Niagara Service. The press you want is in stock, ready for immediate shipment.

Bulletin No. 58-D describes Niagara Inclinable Presses. Send for your copy today! Let us quote.

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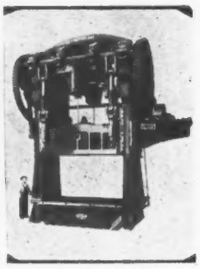
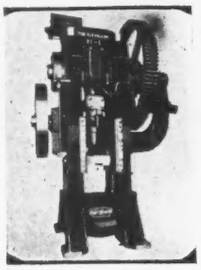
CLEVELAND FOR

Cleveland Power Presses are fully up to the minute in design and construction and embody every conceivable feature for high speed and economical production.

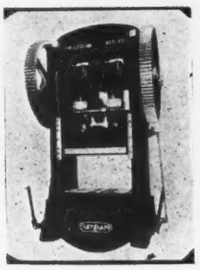
This is true of every type and size of our entire line which embraces from the smallest Open Back Inclinable to the largest Double Crank Toggle—write for specifications.



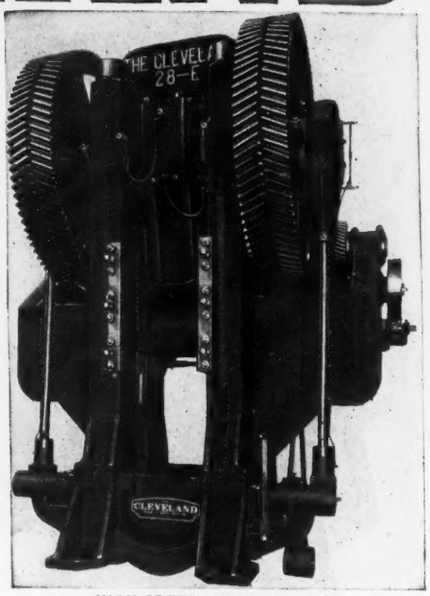
DOUBLE CRANK TOGGLE PRESS



STRAIGHT SIDED SINGLE ECCENTRIC PRESS



STRAIGHT SIDED DOUBLE ECCENTRIC PRESS



HIGH SPEED FORGING PRESS

The Cleveland Punch & Shear Works Co., Cleveland, Ohio

NEW YORK—CHICAGO—DETROIT—PITTSBURGH—PHILADELPHIA

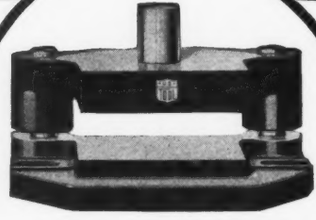
A No. 55 Atlas 10-ton Press arranged for line shaft drive—one of a wide range of models and sizes.

ATLAS power

Whether your work requires a slow measured stroke or high speed stamping action, Atlas Presses have adequate *power*. On all kinds of broaching, straightening and forming work you can depend on an Atlas to deliver the maximum in accuracy and economical production. S K F bearings throughout are just one reason for smooth operation and long life.

Write for details of the advantages that have made Atlas Presses favorites throughout industry.

The Atlas Press Co.
Kalamazoo, Michigan

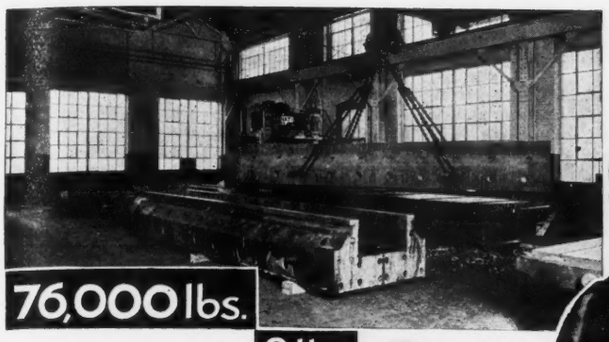


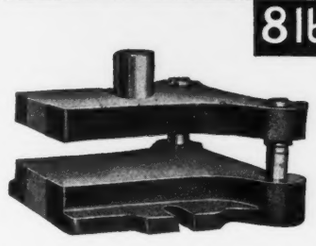
EXCEPTIONAL PERFORMANCE

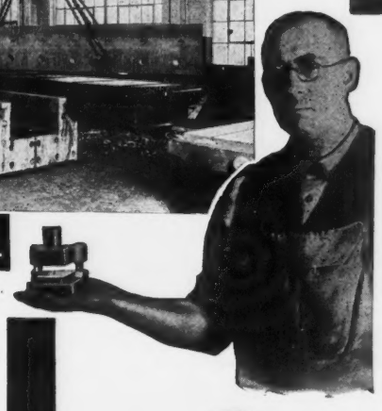
U.S. Tool Die Set performance is exceptional because its design incorporates many exclusive features that make for smooth operation and long life. Unusually long leader pin bearings, an unobstructed working surface, and a system of positive lubrication are important factors in U. S. Tool efficiency. Sets are available unbushed or with hardened and ground steel bushings.

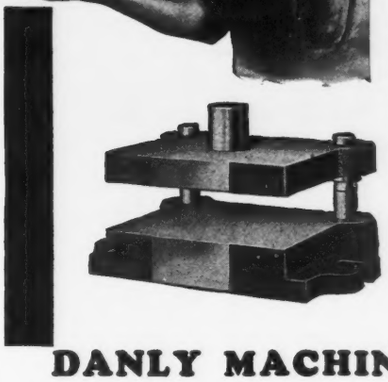
Write for Catalog and full description.

U.S. TOOL COMPANY, INC.
AMPERE, NEW JERSEY, U.S.A.









Danly makes them LARGE or SMALL

IF it's a die set, Danly can make it . . . one or a carload, minute or huge.

There is a complete line of Danly Standardized Interchangeable Die Sets, available for immediate delivery from each of the Danly assembly plants. You save money by using these and reap all the benefits resulting from bulk production carried out under ideal conditions.

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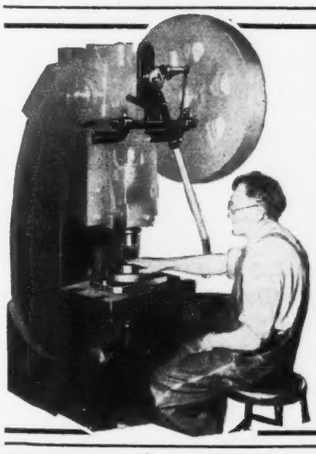

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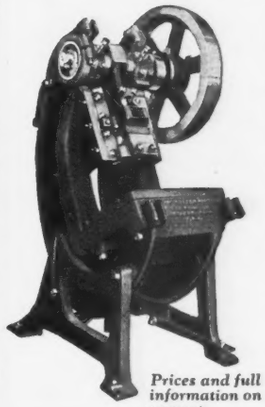

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These presses are found in the country's foremost plants. Their advanced design—the outgrowth of over 40 years of press building experience—assures precise, economical production on blank cutting, forming, shaping and perforating.

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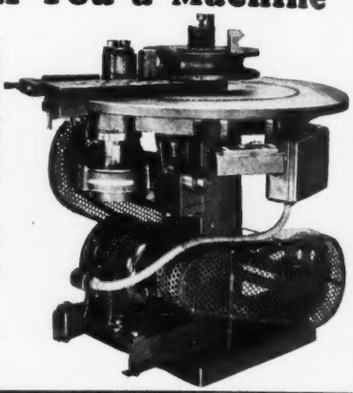

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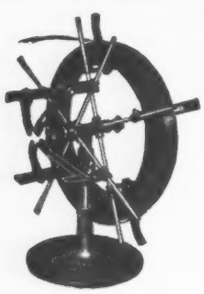

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for hand feeding.

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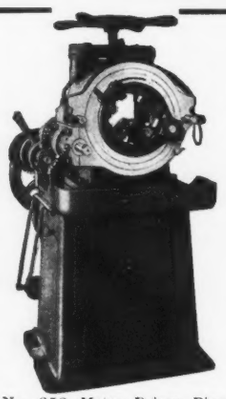

No. 258 Motor Driven Pipe Cutting and Threading Machine, range 1—6" R.H.

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MODELS
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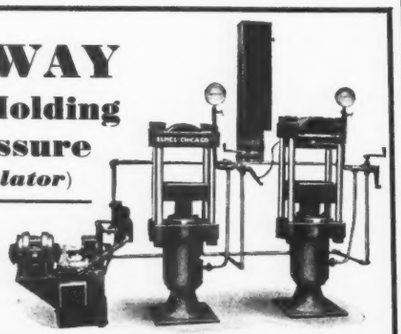

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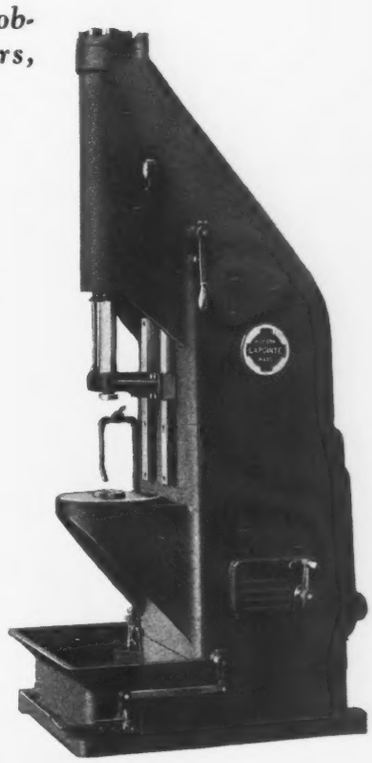
Broaches by Lapointe are not made to meet competition in quality, but to set a standard for competition to meet. Try them—they're moderately priced, faster, more accurate; they'll bring your broaching costs way down.

Discuss your broaching problems with our engineers, without obligations.



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Circulars containing detailed description of all features and capacities await inquiries. Send for a copy.

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Pioneers
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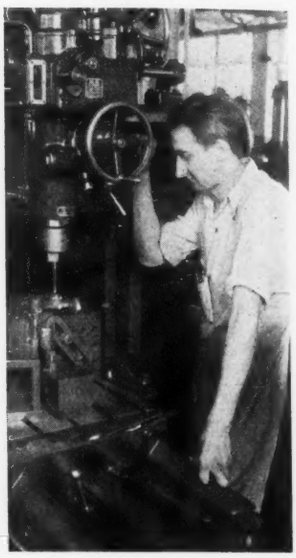

Operators like to run the S. I. P. Swiss Jig Borer. They like the handy location of all levers, the easy motion of the operating handwheels, the smoothness of the spindle feeds. They admire the straightness and flatness of the sliding surfaces, and approve the large scale reading drums. But most of all they like the results. They know that even when they work at top speed, the job will go through the inspection department with every dimension marked *OK*. That *is* confidence.

Direct readings are taken to .00005" without the use of end measures, slip gauges, or micrometers. Other interesting facts are shown in pamphlet 1001. Ask for it.

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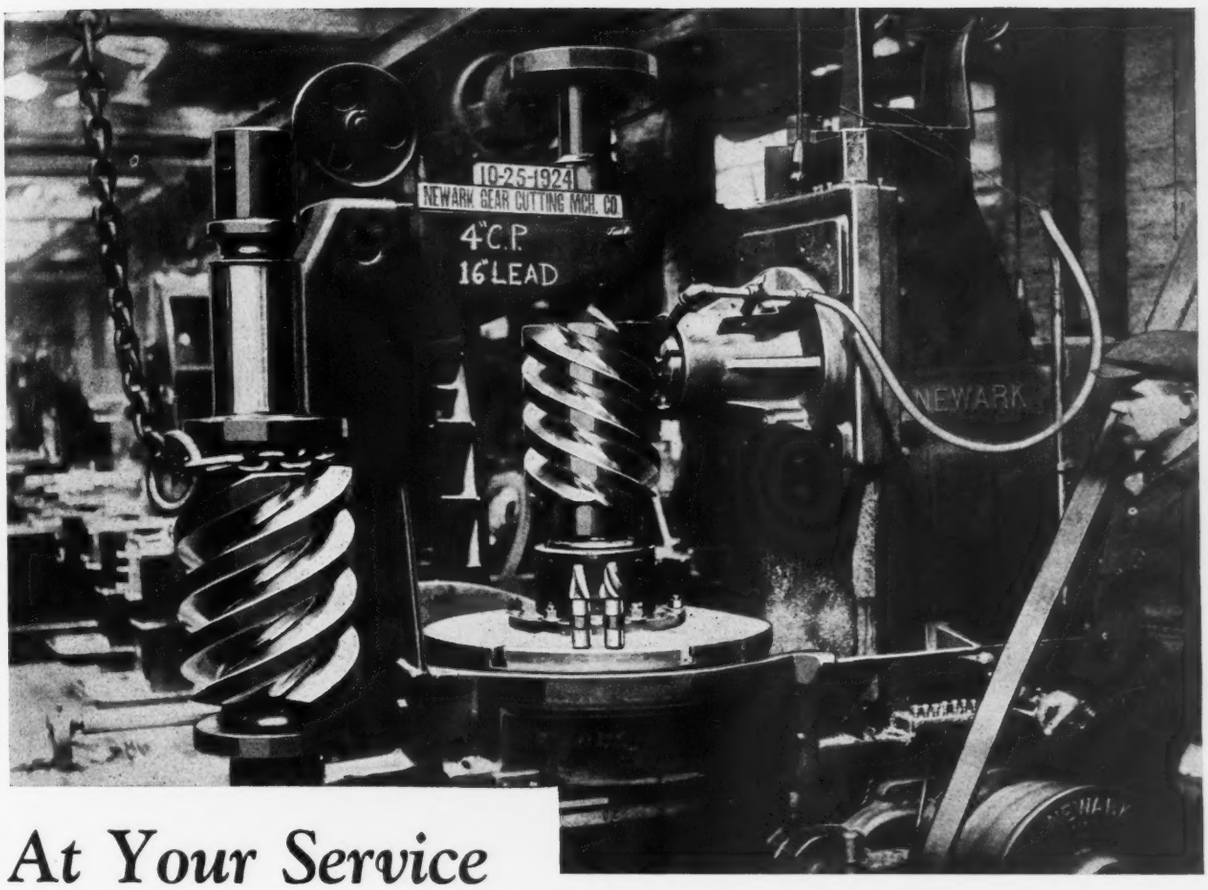

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Machine manufacturers know the reputation of Newark Gear Cutting Equipment—appreciate the quality and economy of Newark cut gears. Many users of gears in large quantities are Newark equipped for efficient gear production. Our contract shop is at the service of those whose needs do not warrant such Newark installations—placing at their command a reliable source of supply for quality gears of any size or type in any quantity at economical prices.

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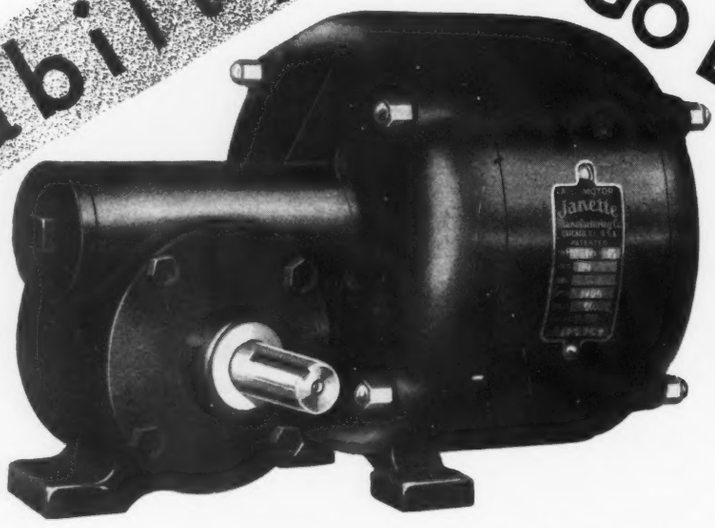

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. . . When you build Your Machine around a Janette Motorized Speed Reducer

A small motor-driven, slow speed machine is More Compact—More Efficient—More Attractive—when it is built around a Janette Motorized Speed Reducer. At the same time the combination of motor, coupling and speed reducer in one unit simplifies design, makes possible production economies and eliminates several assembly operations. The result is a More Salable unit Produced for Less. Janette Motorized Speed Reducers are made in Single and Double Reduction Worm Gear types and Single Reduction Spur Gear type. Standard ratios from 2 : 1 to 60 : 1. Special ratios furnished to order. Sizes 1/30 to 3/4 H.P.

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Embodied in IXL Reducers is the best that engineering skill, precision manufacturing methods, and carefully selected materials can produce. Their design is based on a careful study of the requirements in various industrial fields, backed by a thorough knowledge of speed reducer design and manufacture gained over a period of thirty years.

IXL Speed Reducers are made in Spur, Worm, Helical, and Herringbone Types for horizontal, vertical, or right angle drives---fractional H. P. up to 300 H. P. and reduction ratios from 2 to 1 up to 50000 to 1. There's a size and type for every possible requirement.

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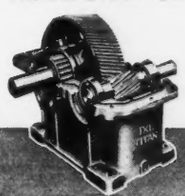

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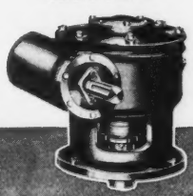
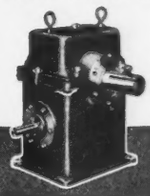


IXL HYGRADE WORM REDUCER



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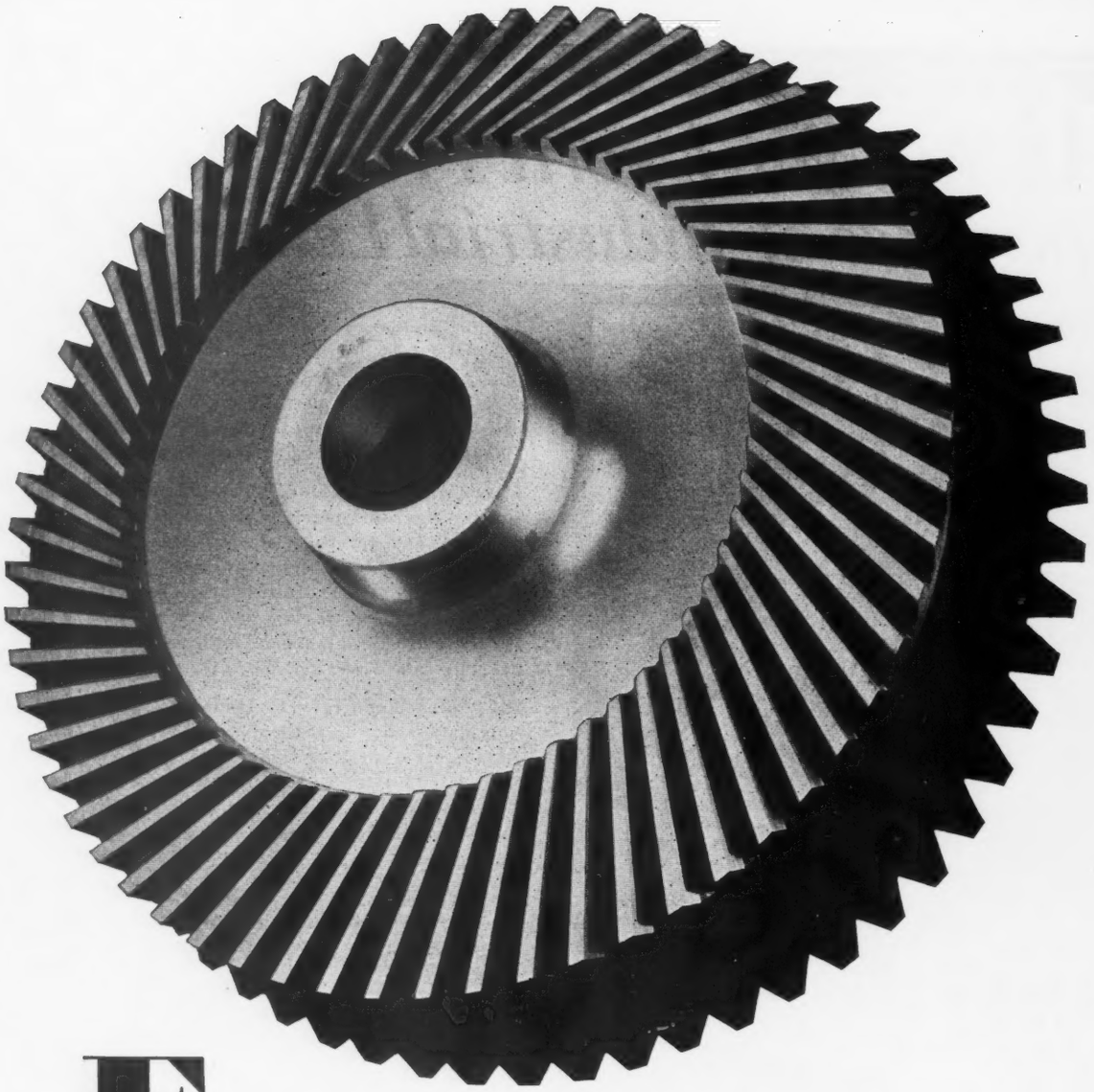

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POWER SAVING PRODUCTS

Gears—Spur, Worm, Herringbone, Internal, Bevel, Miter, Intermittent, Spiral, Helical, Continuous Tooth Herringbone and Spiral Bevel Gears.—*Non-Metallic Pinions*—Fabroil, Textolite, Rawhide.—*Speed Reducer Units*—All types, all ratios, for all drive conditions.—*V-Belt Drives*—A complete line. *Miscellaneous*—Whitney Silent and Roller Chains, Sprockets, Flexible Couplings, Universal Joints, Racks, Ratchets and Pawls.

WHATEVER your gear requirements, Philadelphia can serve them. For the Philadelphia Gear Works is machined and manned to produce any type of standard or special gears in any sizes, in any quantity, offering quick service to meet the emergency when necessary.

That is why Phillie Gear customers are legion—why one after another manufacturer has discovered that it pays to standardize on Phillie Gears.

Why not come to gear headquarters for assistance in your gear work? Fifty years of experience in sound gear engineering is at your disposal. And remember, Phillie Gear Service is not legendary—it is a daily fact. Try it.

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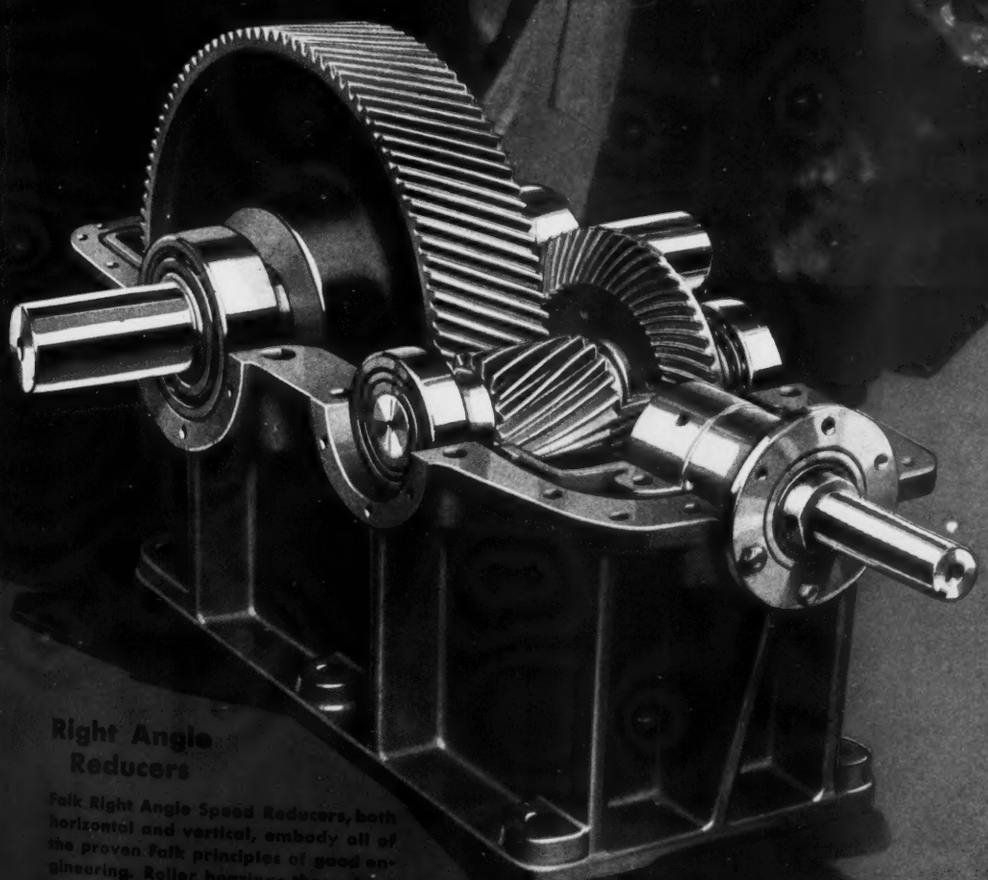
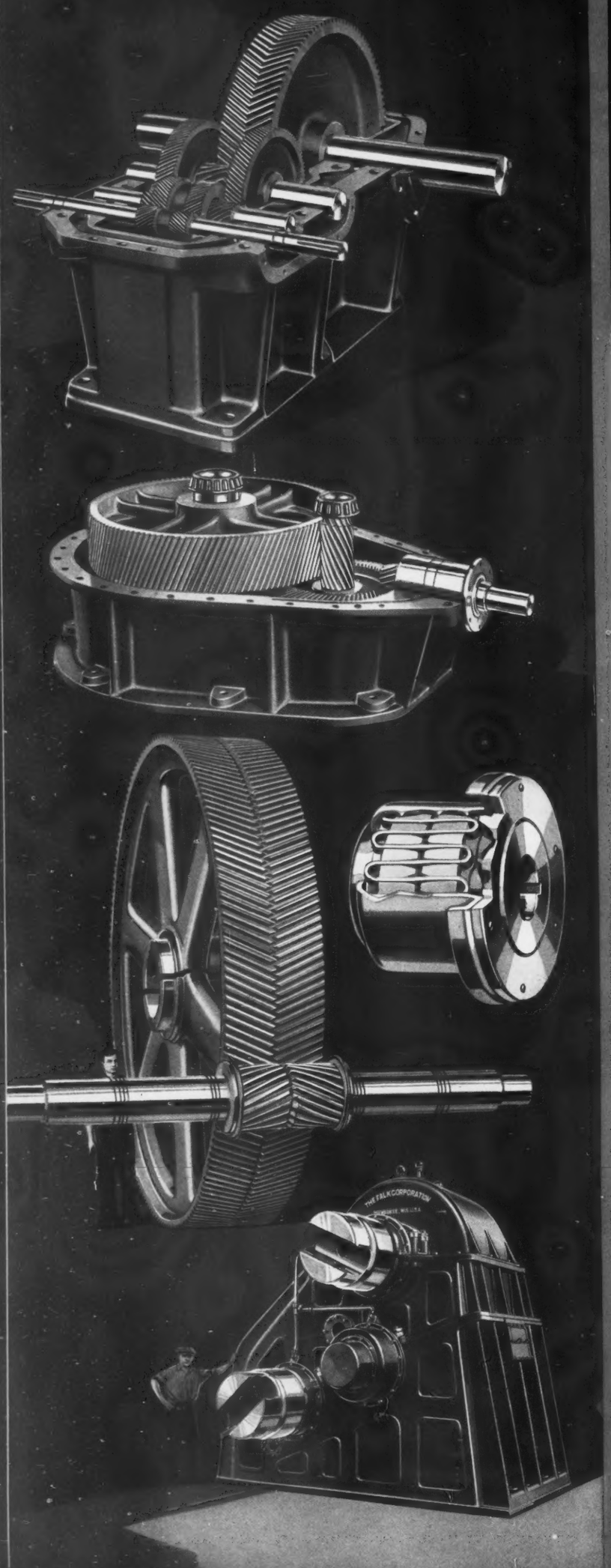


Right Angle Reducers

Falk Right Angle Speed Reducers, both horizontal and vertical, embody all of the proven Falk principles of good engineering. Roller bearings throughout ... positive lubrication ... absolutely oil-tight housing ... rugged construction ... high efficiency and cool operation assure long, trouble-free service.

MEN, with personal pride in a good job well done, build something more than machine precision into Falk Herringbone Gears. Throughout the Falk plant you will find men whose sincerity and faith are expressed in the perfection of their work. Each job is a challenge to their ability to achieve perfection ... Falk's faith in these craftsmen is expressed in a guarantee of complete satisfaction to users of Falk Herringbone Gears, Heavy Units, Speed Reducers and Flexible Couplings ... and that faith will never be broken.



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Parallel Shaft Speed Reducers★

Absolute reliability for continuous duty is built into Falk Speed Reducers. Each unit will safely transmit its full rated capacity under continuous operation . . . and has 100% reserve for momentary overloads. Lubrication is positive . . . and the housings are absolutely dust and oil-tight. Carried in stock for immediate shipment.

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Falk Right Angle Vertical Speed Reducers are quiet and cool running and can be depended upon for continuous service day after day, year after year. Fully enclosed and positive lubrication. On mixers and agitators this vertical drive permits placing the motor beyond reach of fumes . . . and eliminates the necessity of oiling open gears directly over the mixture.

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Its unique shock-absorbing qualities make the Falk Flexible Coupling an effective means of protecting motor and driven machine from shocks and vibration. It also allows lateral and torsional elasticity; floats freely under load; is easily connected and disconnected; is all steel; is perfectly lubricated; provides great resistance to overloads; cannot rust; has no parts to work loose; accommodates parallel and angular misalignment. Sizes 1/5 to 18,000 H. P. at 100 r.p.m. carried in stock.

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There is no greater proof of this fact than the testimony of thousands of satisfied users now on record.

Will you let us show you, too, the Royal Road to Economical Operation?

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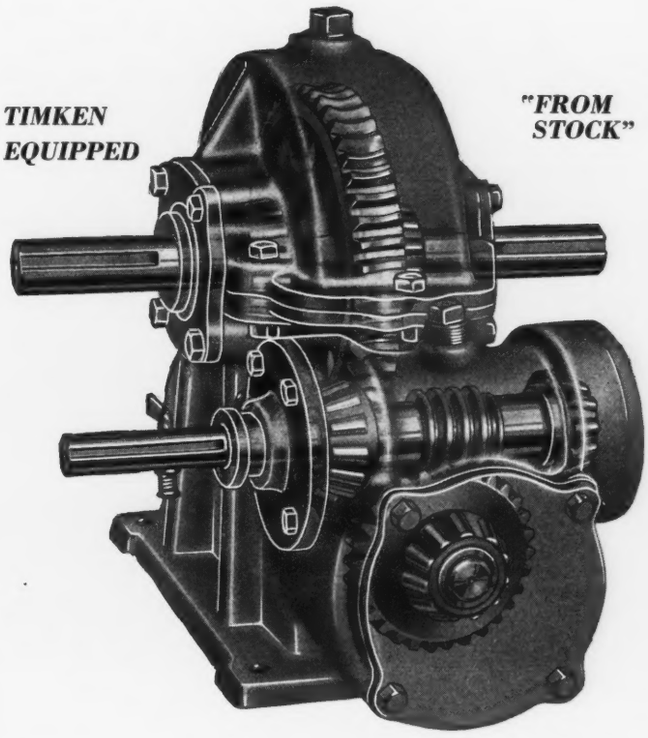

A useful little book on Speed Reduction, sent gladly and without any obligation whatever.

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BILGRAM METHODS

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Quality Gears
Efficient Service
Economical Machine Construction

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HELICALS
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BEVELS
SPURS
HYPOIDS
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WORMS
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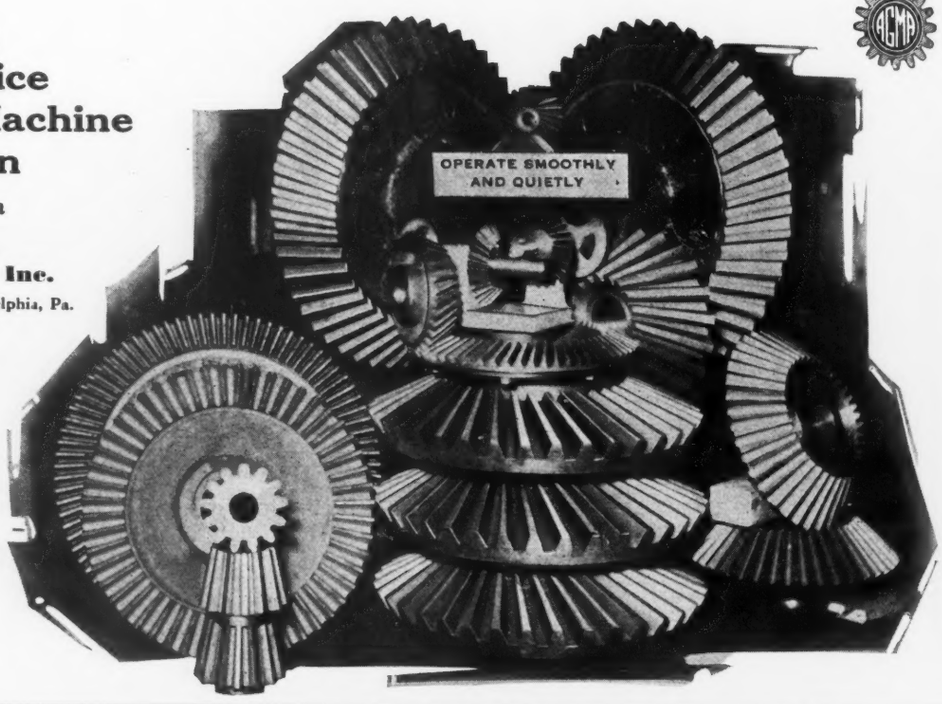


HARTFORD GEARS

QUALITY - ACCURACY - ECONOMY

SPUR GEARS
CAM CUTTING
BEVEL GEARS
WORM WHEELS
THREAD MILLING

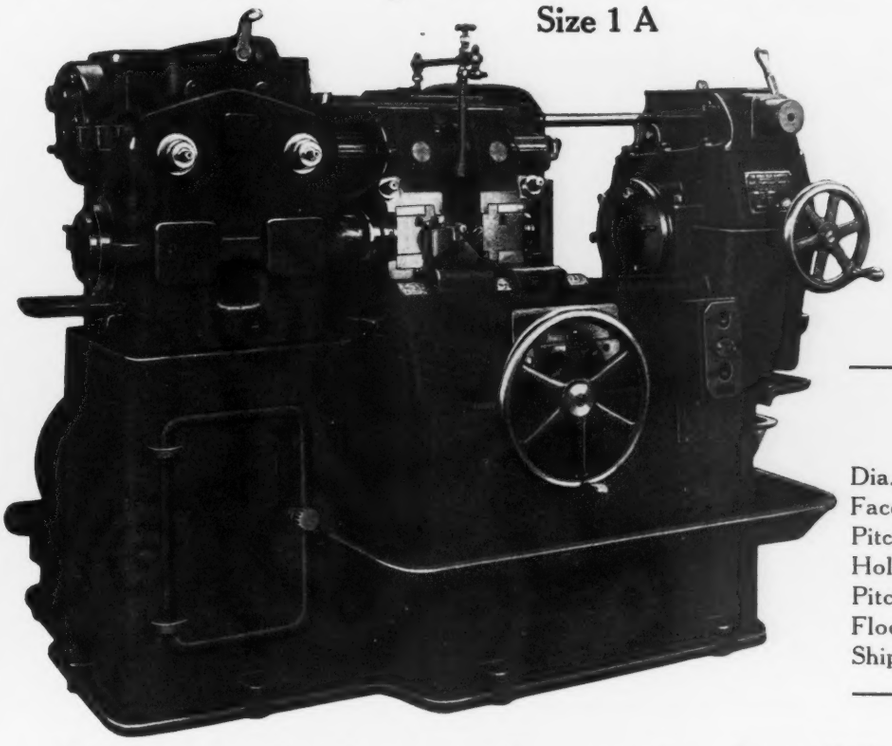
HARTFORD GEARS

THE HARTFORD SPECIAL MACHINERY CO.
293 HOMESTEAD AVE., HARTFORD, CONN.

Precision Gear Generating on

The New Sykes Gear Generator

Size 1 A



850 Cutting Strokes per Minute

CAPACITY

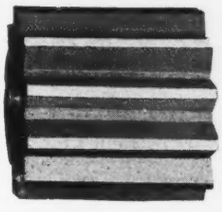
	Spur and Helical	Herring-bone
Dia.	¼" to 12"	¼" to 12"
Face	¼" to 2½"	¼" to 4"
Pitches	24 D.P. to 4 D.P.	
Hole in Spindle	3¾" dia.	
Pitch Diam. of Cutters	4"	
Floor Space	4'-7"x6'-0"	
Shipping Wgt.	7500 Lbs.	

The New Sykes Gear Generator will generate **Spur Gears, Helical Gears, Cluster Gears Simultaneously, Double Helical Gears** with a center groove—teeth matched or staggered—with helices of similar pitch or dissimilar pitch, and the well known **Sykes Continuous Tooth Herringbone Gear.**

The gears generated are **Precision** gears, smoothly finished and silent in operation.

The cutting speed is so high—850 cutting strokes is the continuous speed, not merely a stunt performance—that the cost of cutting is equal or less than the cost of ordinary commercial gears.

Twenty years of continuous specialized effort is behind the design, and ninety years of manufacturing experience is behind the manufacture. There is no experimentation, no risk of interrupted production, no fear of early obsolescence.



Spur Gears

Helical Gears

Cluster Gears Cut Simultaneously

Double Helical Both Helices Cut Simultaneously

Herringbone Both Helices Cut Simultaneously

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SUCCESSOR TO

FARREL FOUNDRY & MACHINE CO., ANSONIA, CONN., & BUFFALO, N.Y., AND BIRMINGHAM IRON FOUNDRY OF DERBY, CONN.

ADDRESS REPLIES TO THIS ADVERTISEMENT TO BUFFALO PLANT, 377 VULCAN ST., BUFFALO, N.Y.

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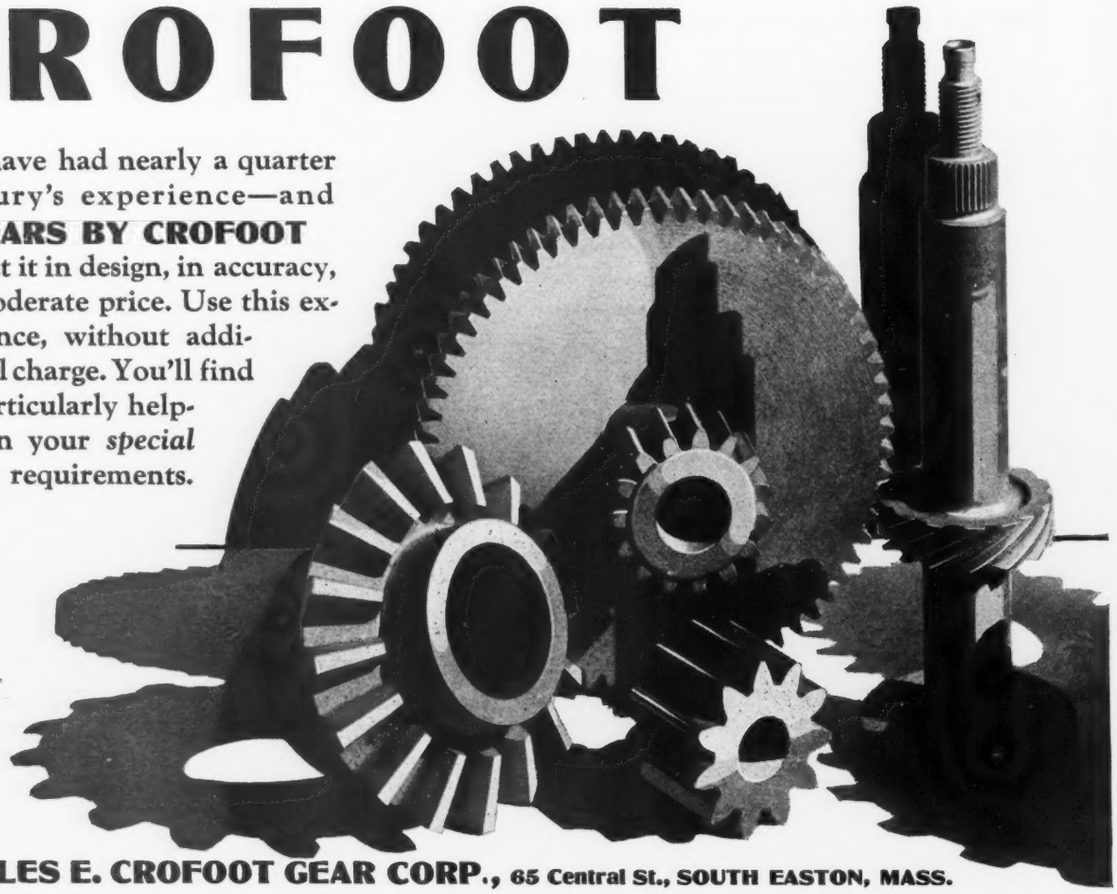
We have had nearly a quarter century's experience—and **GEARS BY CROFOOT** reflect it in design, in accuracy, in moderate price. Use this experience, without additional charge. You'll find it particularly helpful on your *special* gear requirements.



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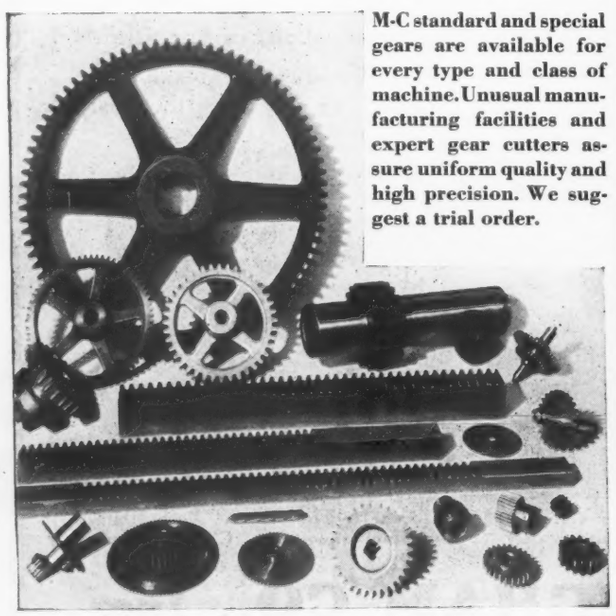

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All Metal Silent Gears

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SILENT CHAIN DRIVES

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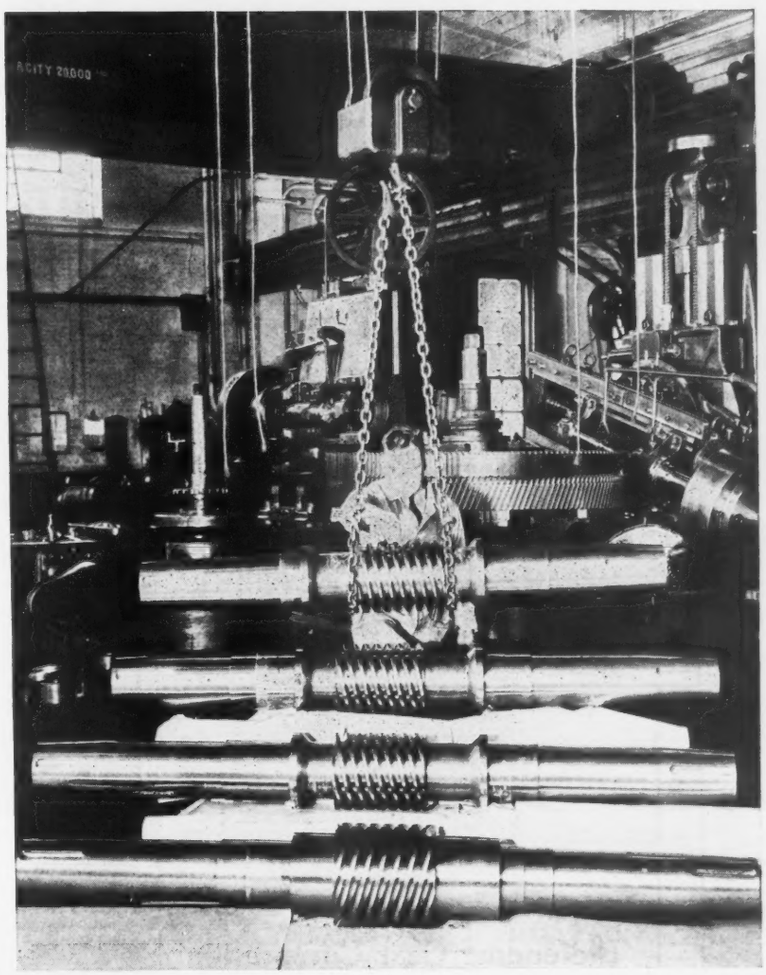

IT'S *performance*—not *promises* that wins re-orders for Horsburgh & Scott Gears—and a considerable proportion of our business comes from re-orders of satisfied users.

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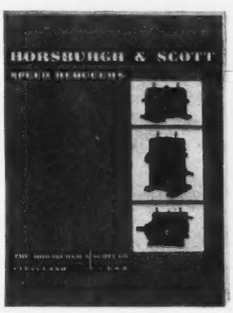

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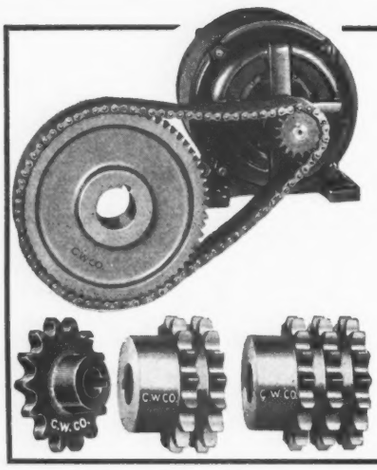

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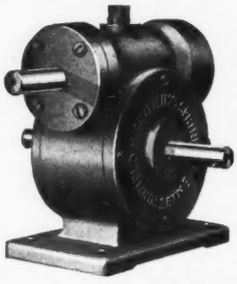

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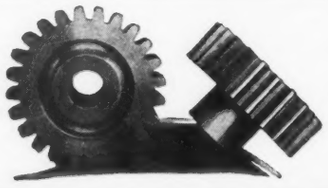

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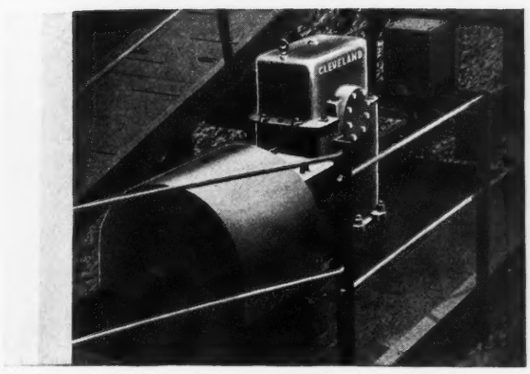
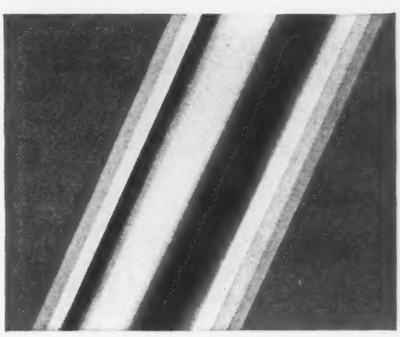


600AT Cleveland Unit driving a belt conveyer Ratio 10¾ : 1, 50 h.p. at 485 r.p.m.

"CLEVELANDS" set the standard of quality



ALMOST anyone can design a worm gear of some sort—but it takes exceptional experience and care to design and build one that is thoroughly dependable. "Cleveland" units *are* dependable—but not by accident.

On all production for standard jobs Cleveland begins with the most accurate patterns—three sided chill castings—equipment that costs real money.

Every ounce of metal entering into the gear is virgin—Lake copper and Straits tin. "Cleveland" does not even use its own borings in the melt, because every time that metal is heated, its characteristics change—"Cleveland" takes no chances.

Steel for worm shafts costs more than ordinary steel—because it is tougher. It requires longer machining time. "Cleveland" gives this steel a double heat treatment and pays extra for normalizing the forgings before they go into the shop.

Cleveland builds its own thread grinders—and its own hobs—more expensive but they turn out a superior product.

And finally, "Cleveland" offers an unequalled engineering service, specializing exclusively in one field, worm gearing and worm gear speed reducers.

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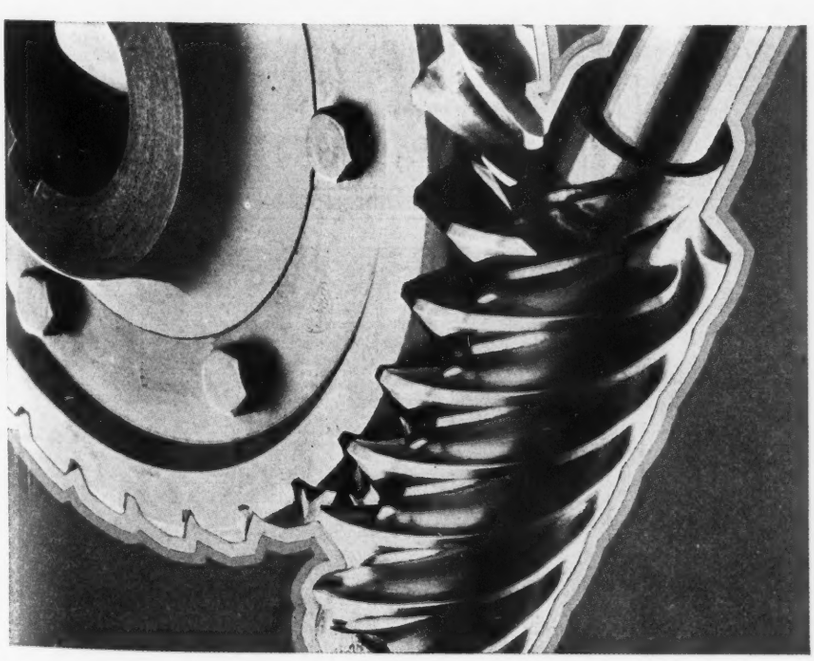

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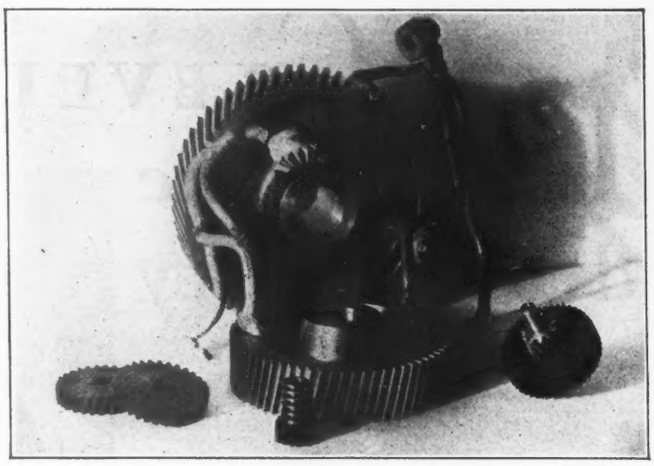

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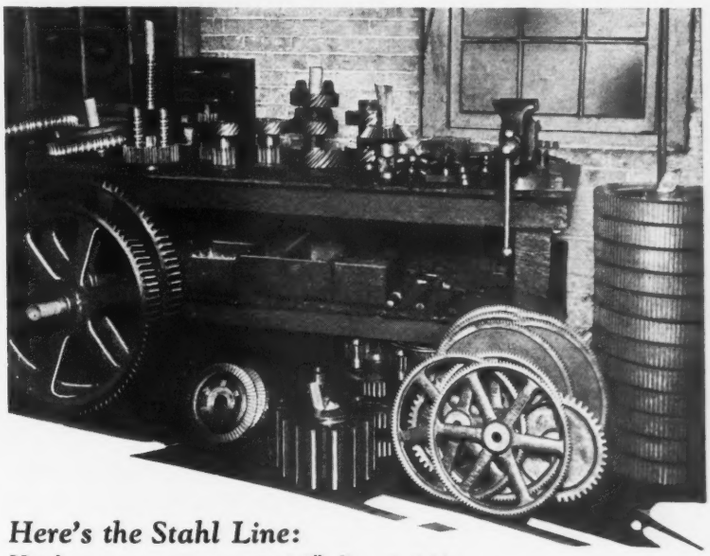
Send your blueprints to Stahl for Estimates



Here's the Stahl Line:

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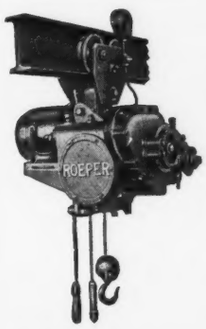

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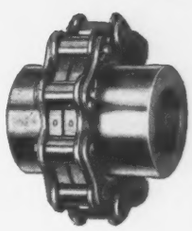

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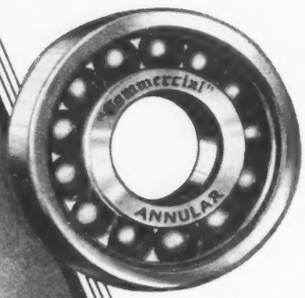

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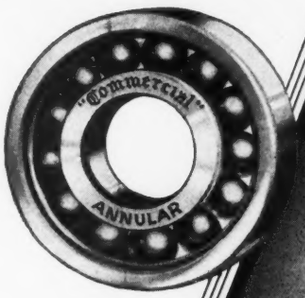

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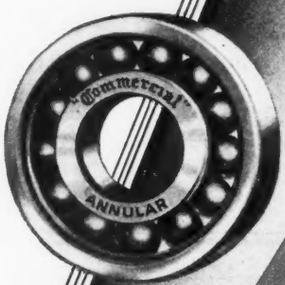

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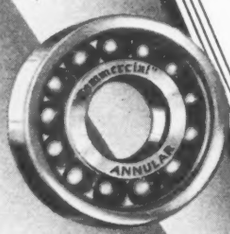

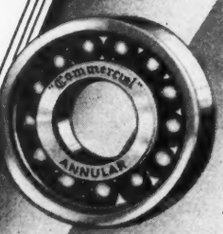

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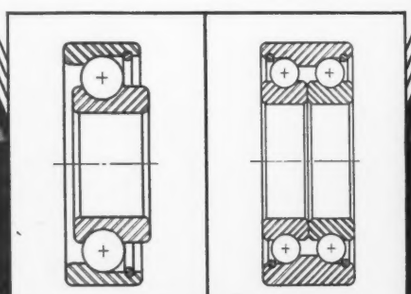

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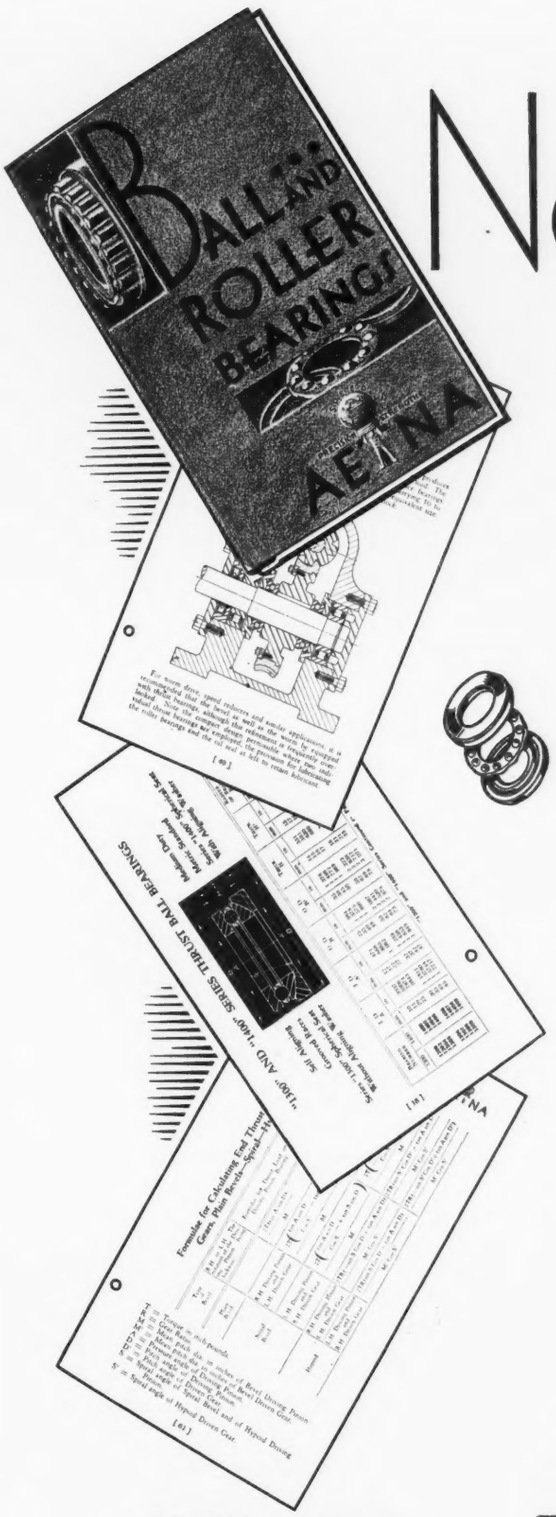

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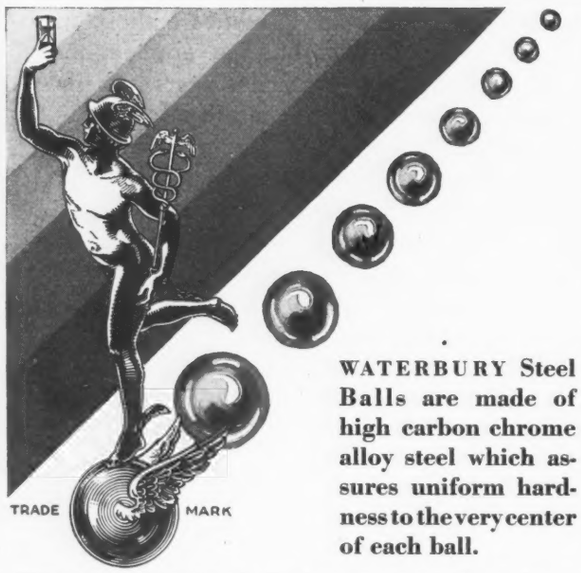

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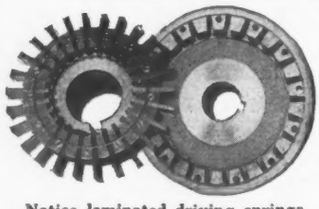
Here's Economical Machine Insurance

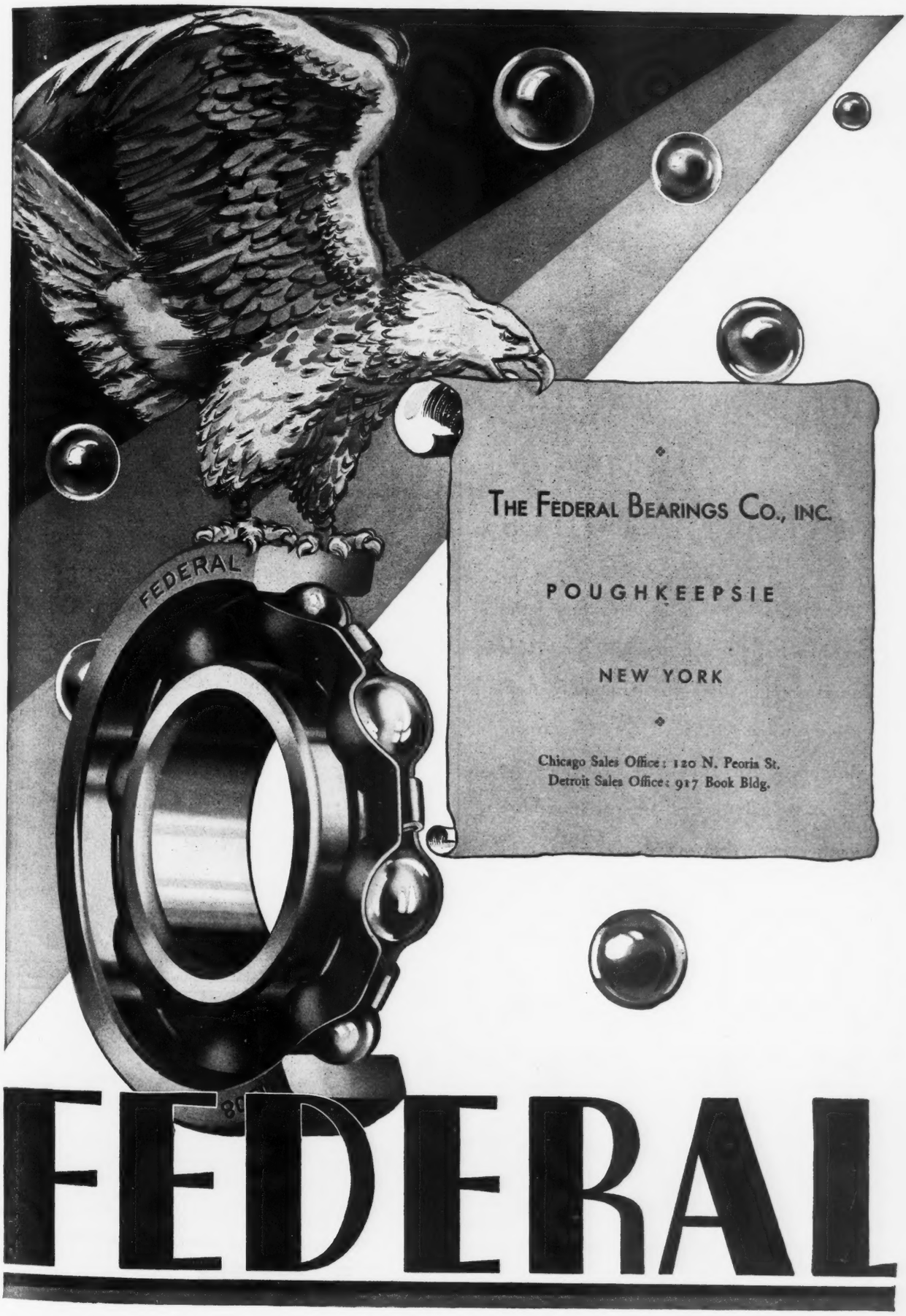


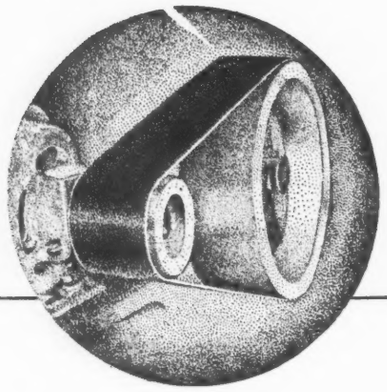
Notice laminated driving springs and taper-side slots. All parts are made entirely of long-lived metals—worn parts quickly and easily replaced.

Your shop machinery is entirely too valuable to permit the use of any but the very finest shock-absorbing equipment. That's why shops that are really efficient have for years standardized on Brown Resilient Couplings. They assure a minimum of "down-time" and depreciation by correcting misalignments; their heavily laminated steel springs work in taper sided slots to absorb shocks and jars and protect delicate parts from sudden strain.

Brown Resilient Couplings are economical to install—well worth investigating. Write for details.

BROWN ENGINEERING CO., 133 N. 3rd Street READING, PA.


FEDERAL
THE FEDERAL BEARINGS CO., INC.
POUGHKEEPSIE
NEW YORK
Chicago Sales Office: 120 N. Peoria St.
Detroit Sales Office: 917 Book Bldg.
FEDERAL



VIM BELTING

PUTS *NEW* ENERGY IN TIRED MACHINE TOOLS

PUT VIM to work on a heavy-duty lathe or shaper and watch the chips fly. VIM is a universal favorite where toughness, tenacious pulley-grip, flexibility and extreme durability are essential. It's made that way—special mineral-tanned long-fibre leather, expertly worked.

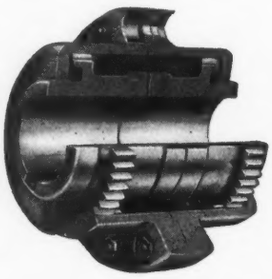
Don't say a leather belt can't do a job until you've tried VIM!

E. F. HOUGHTON & CO.

PHILADELPHIA

AND ALL OVER THE WORLD

LEATHER VIM BELT



★

POOLE Flexible Couplings

protect your machines

Your equipment is adequately safeguarded against wear, breakdowns and costly maintenance when you specify Poole Flexible Couplings. They are made of forged steel, sealed against dust, grit and moisture and fully lubricated. Write today for "Flexible Couplings"—The Poole book of facts. It's yours for the asking.

POOLE ENGINEERING & MACHINE CO.

3730 Clipper Mill Road, Baltimore, Md.

Every Shop needs a CANTON

The Canton Portable Floor Crane, although small and handy, does the lifting work of three or four men. It can be rolled to remote corners of your shop inaccessible to large overhead cranes. Low base goes under almost any machine. Write for details.

Lifting Capacity 3 tons.

CANTON FOUNDRY & MACHINE CO.

CANTON, OHIO

New York Office: 154 W. 57th St.

representing YOU

YOUR name, trade mark or other insignia marked or stamped on your goods adds value to your products and helps maintain their markets.

It is with this viewpoint that this marking is to be your representative that Schwerdtle builds finer, stronger, better steel stamps and dies.

Your request for additional information or quotation will receive our prompt attention.

THE SCHWERDTLE STAMP COMPANY

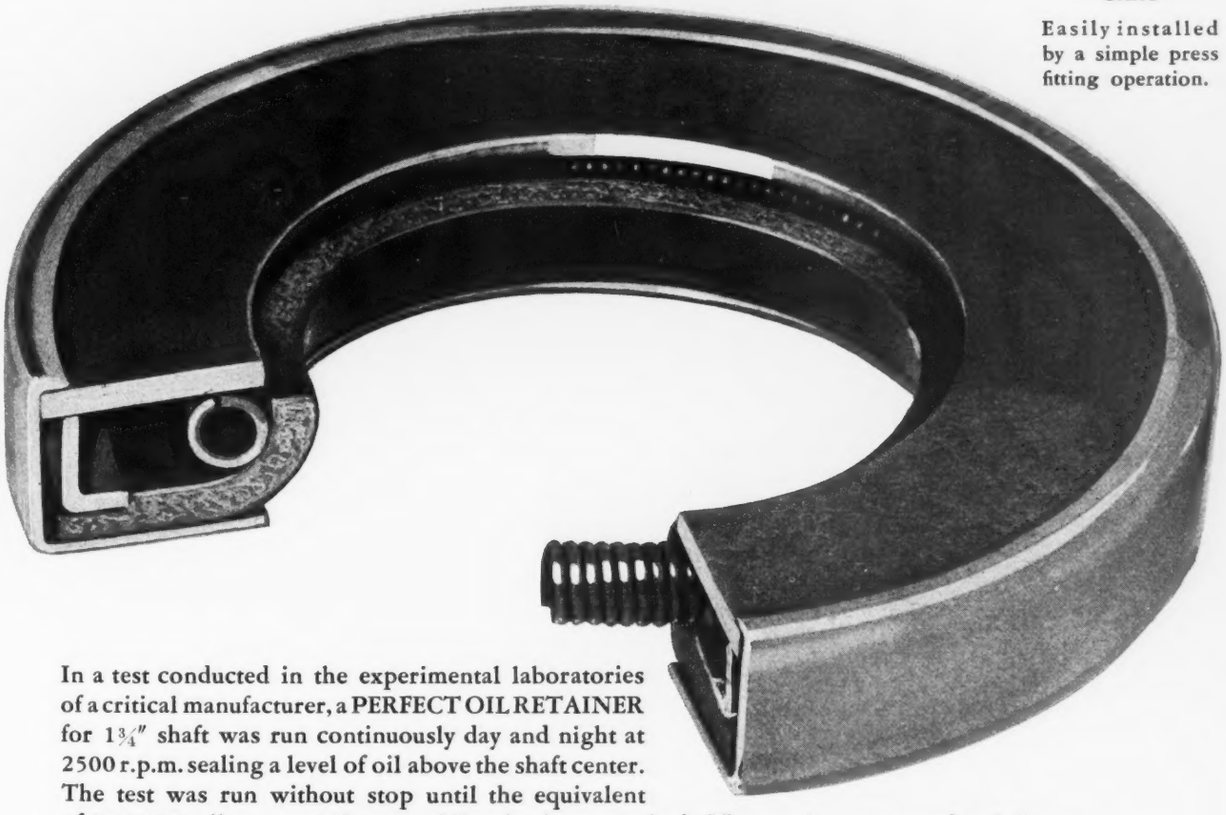
21 CANNON STREET BRIDGEPORT, CONN.

Convincing Evidence of Merit!

THE PERFECT OIL RETAINER *on test* CONTINUES TO *retain lubricant* AND *protect bearings* AFTER THE EQUIVALENT OF 900,000 AUTOMOBILE MILES

COMPACT SELF-CONTAINED UNITS

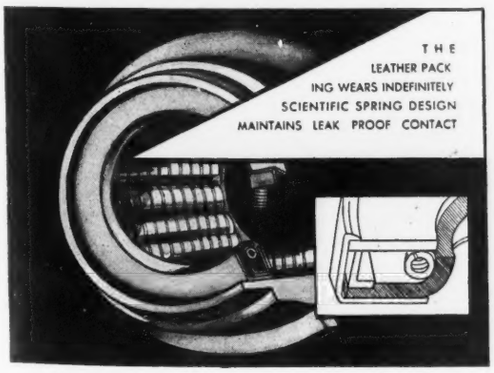
Easily installed by a simple press fitting operation.



In a test conducted in the experimental laboratories of a critical manufacturer, a PERFECT OIL RETAINER for 1¾" shaft was run continuously day and night at 2500 r.p.m. sealing a level of oil above the shaft center. The test was run without stop until the equivalent of 900,000 miles on a 34" automobile wheel was reached. The results were noted as follows:

THERE WAS NO LEAKAGE! THE PERFECT OIL RETAINER SHOWED NO WEAR!

From all indications, this seal would have continued functioning perfectly for another similar period. Our engineers will gladly cooperate with you in solving your oil and grease sealing problems. It is of utmost importance that your inquiry be accompanied by complete mechanical details.



Perfect OIL RETAINERS

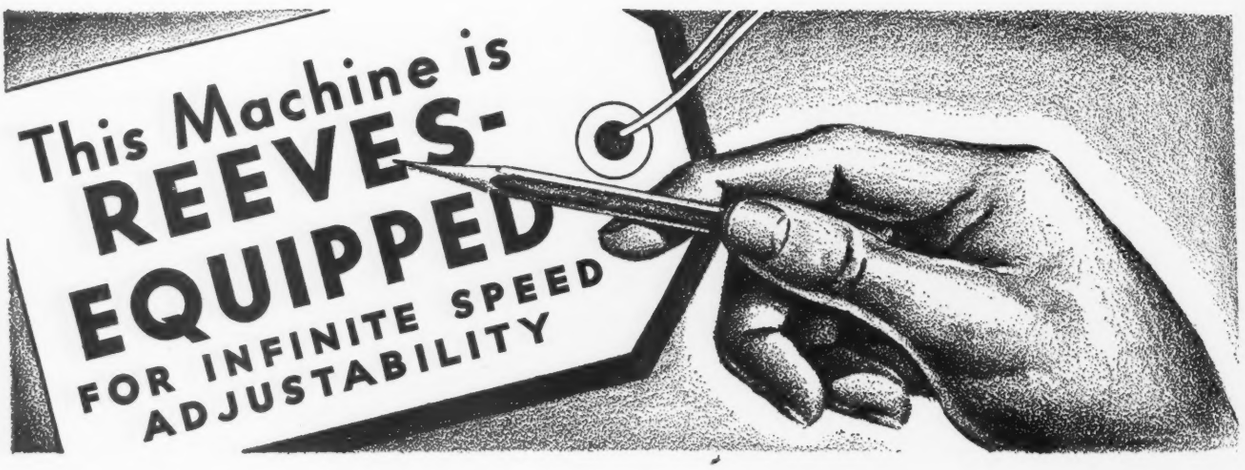
The CHICAGO RAWHIDE MANUFACTURING CO.

1302 ELSTON AVE., CHICAGO

Branches: NEW YORK, DETROIT, CLEVELAND, PHILADELPHIA, PITTSBURGH

IF MADE OF LEATHER FOR MECHANICAL PURPOSES WE MAKE IT

Here's the "Clincher" in Thousands of Machinery Sales

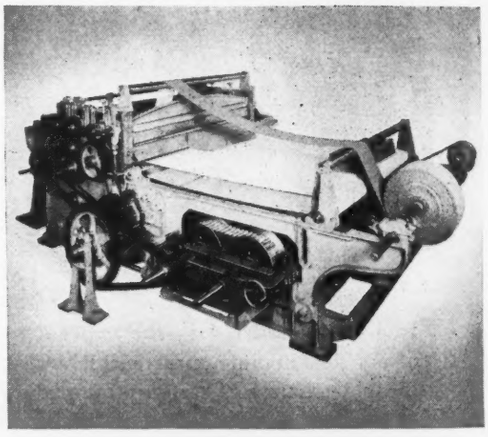


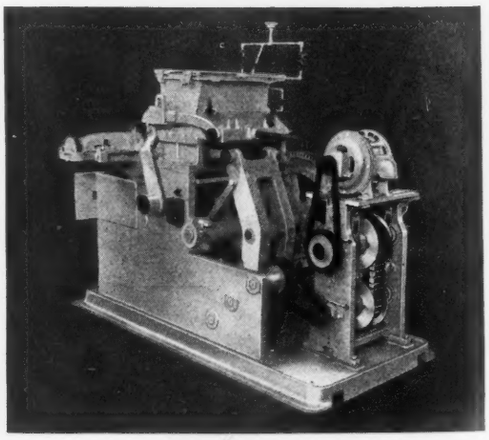
● Two machinery salesmen, both fighting for the same order—two competitive machines, facing the critical comparison of the careful buyer. In many respects, both machines have equal merit. What will influence the buyer's decision—what factor will "clinch" the sale?

One Machine is standardly equipped for infinite speed adjustability, provided by the Reeves Variable Speed Transmission. The *full* efficiency and utility of this machine may be attained for the many different operations or products to which it is adaptable, under all changing production conditions, by means of full-range, accurate speed selectivity.

The Other Machine lacks this essential feature. Either the buyer must purchase and install a speed-control unit to get the production economies assured by complete speed flexibility, or he must be content with the costly limitations of a fixed, inflexible speed.

These two opposing factors stand out sharply in the buyer's mind. The issue is clearly defined—he makes his decision promptly and wisely.... There's no question which machine he selects—there's no question what clinched the sale!





Above illustrations show two of the hundreds of REEVES*-equipped machines.*

REEVES
Variable Speed Transmission

• MORE THAN 50,000 IN SERVICE—STANDARD EQUIPMENT ON MORE THAN 600 MACHINES •

REEVES PULLEY CO., COLUMBUS, INDIANA

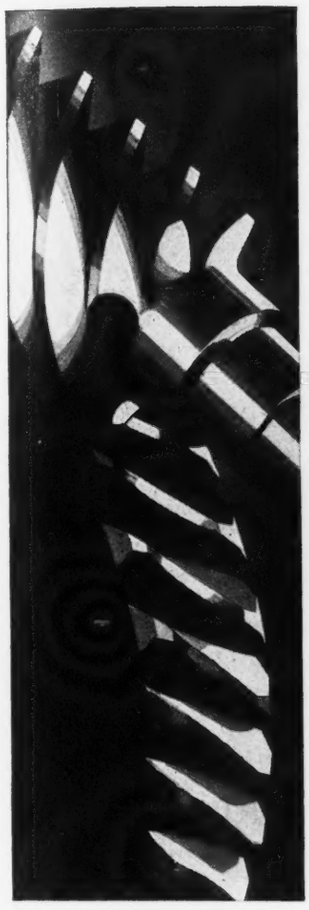
☐ Please have your nearest representative arrange an appointment to call on me.

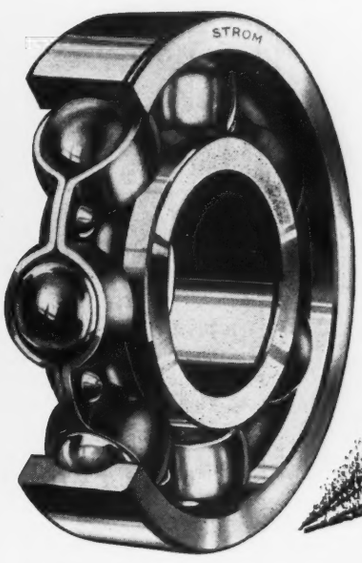
☐ Please send free copy of Handbook of Variable Speed Control M-12.

Name.....

Company.....

Address.....



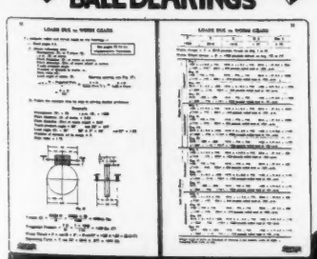


Super-Stroms Supply Rigid Shaft Support *for* Worm Drives

Worm gears demand an exceptionally rigid shaft support to maintain proper meshing of worm and gear and to minimize wear. Super-Strom Ball Bearings have their place as worm gear supports and also on the worm itself. In these positions the Super-Strom supplies ample capacity for both radial and thrust loads; saves utmost in power; supplies enduring rigidity; eliminates bearing wear and adjustments.

Highest grade steels, made tougher and more wear resisting through proper heat-treating methods . . . Super-Strom design with its extra deep race groove, more or larger balls, sturdy retainers . . . high quality workmanship and careful inspection all combine to form an anti-friction unit of superior quality.

Strom BALL BEARINGS

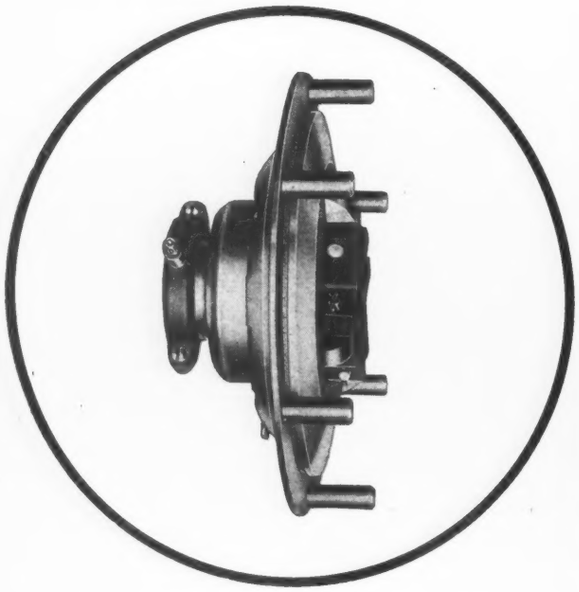


On pages 32 and 33 of the STROM BALL BEARING LOAD COMPUTATION MANUAL Engineers will find a surprisingly simple, time-saving method for computing loads on worm gear drives. Write for it! This 48-page booklet is as reliable and economical as Strom Bearings themselves—and you will find it a valuable addition to your engineering library.

STROM BEARINGS CO.

Division of Marlin-Rockwell Corporation

4563 Palmer Street **Chicago, Illinois**



The CONWAY CLUTCH

has these features:

Easy Engagement
Instant Release
Dragfree Idling
Abundance of Power

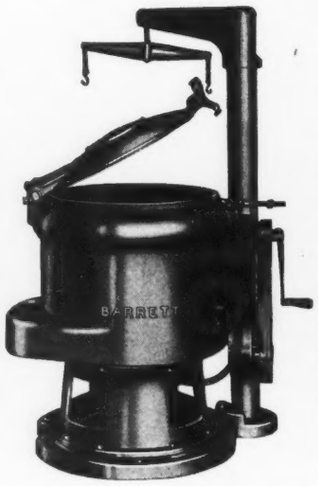
You may find them in another clutch. But not in the matchless blend of consistency and dependability that is found in the patent Conway Clutch. Users who have tried them all tell us the Conway is a combination that can't be equalled.

"The last word in friction clutches" has centripetal action and long wearing parts, all enclosed and balanced. A touch on the lever bar controls every function.

Send the facts of your requirements to our engineers for estimates. No obligation.

THE CONWAY CLUTCH CO.
1547 Queen City Ave. Cincinnati, Ohio
"The Conway Disc is a splendid Clutch"

ECONOMIZING?



Then How About Reducing Your Cutting Oil Expense!

You'd spend $.012 to save a dollar, wouldn't you? Well, that's all it's costing one automobile manufacturer — $12 a day to save $1000 in cutting oil. With Barrett Centrifugals.

Look into this method of reclaiming cutting oil from chips and finished parts for further service. It can effect proportionate savings for you, at the same low cost. All information on request.

THE LEON J. BARRETT CO.
1475 Grafton St. Worcester, Mass., U.S.A.
Centrifugal Dryers Washers Oil Extractors
Centrifugal Research and Engineering

700 Styles and Sizes

OIL SEALS ~ OIL CUPS ~ OIL HOLE COVERS ~ OILERS ~ MULTIPLE OILERS.
CATALOG ON REQUEST

Gits Bros. Manufacturing Co.
1846-62 S. Kilbourn Ave. CHICAGO, ILL.

They're a work of art

Noble and Westbrook Engraved Roll Steel Dies and Press Stamps are made of the best quality steel by skilled workmen. You'll appreciate their artistic effect when you use them. Get the particulars.

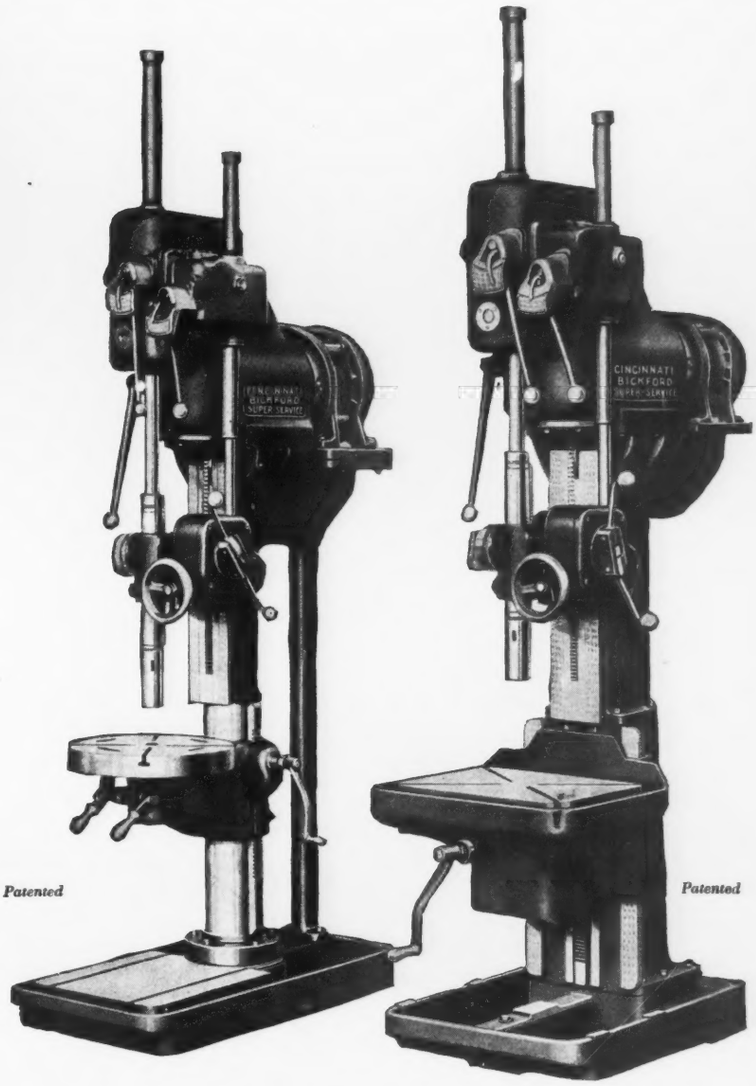
The Noble & Westbrook Mfg. Co.
Manufacturers of Rapid Production Marking Machines, Machines for Automatic Numbering on Metal, Steel Stamps, Brass Checks, etc.
Hartford, Connecticut, U. S. A.

Our Engineering Department will be glad to make a complete study of your coolant problems and suggest an unbiased solution without obligation to you.

GUSHER COOLANT PUMP
THE RUTHMAN MACHINERY CO.
530 E. Front St., Cincinnati, O.

The New Cincinnati-Bickford SUPER-SERVICE Upright Drills

EQUIPPED WITH G-E MOTORS and CONTROL



Left, 21-inch Super-Service upright drill; right, 24-inch type. Both machines manufactured by Cincinnati-Bickford Tool Company; both "Equipped with G-E Motors and Control"

Patented *Patented*

GENERAL ELECTRIC individual motor drive is used on the new Cincinnati-Bickford Super-Service upright drills. This is further acceptance of the economy, the flexibility, and the efficiency of this modern drive system, and of General Electric equipment for machine tools.

General Electric coöperated closely in selecting exactly the right motor and the right control to power these new tools properly. The result is greatest value to the user—value that is reflected in terms of long life, productive capacity, dependability, and economy.

Insist that your machine tools be "Equipped with G-E Motors and Control"; their worth is accurately measured by the confidence everywhere expressed by leading machine-tool designers and builders.

200-509

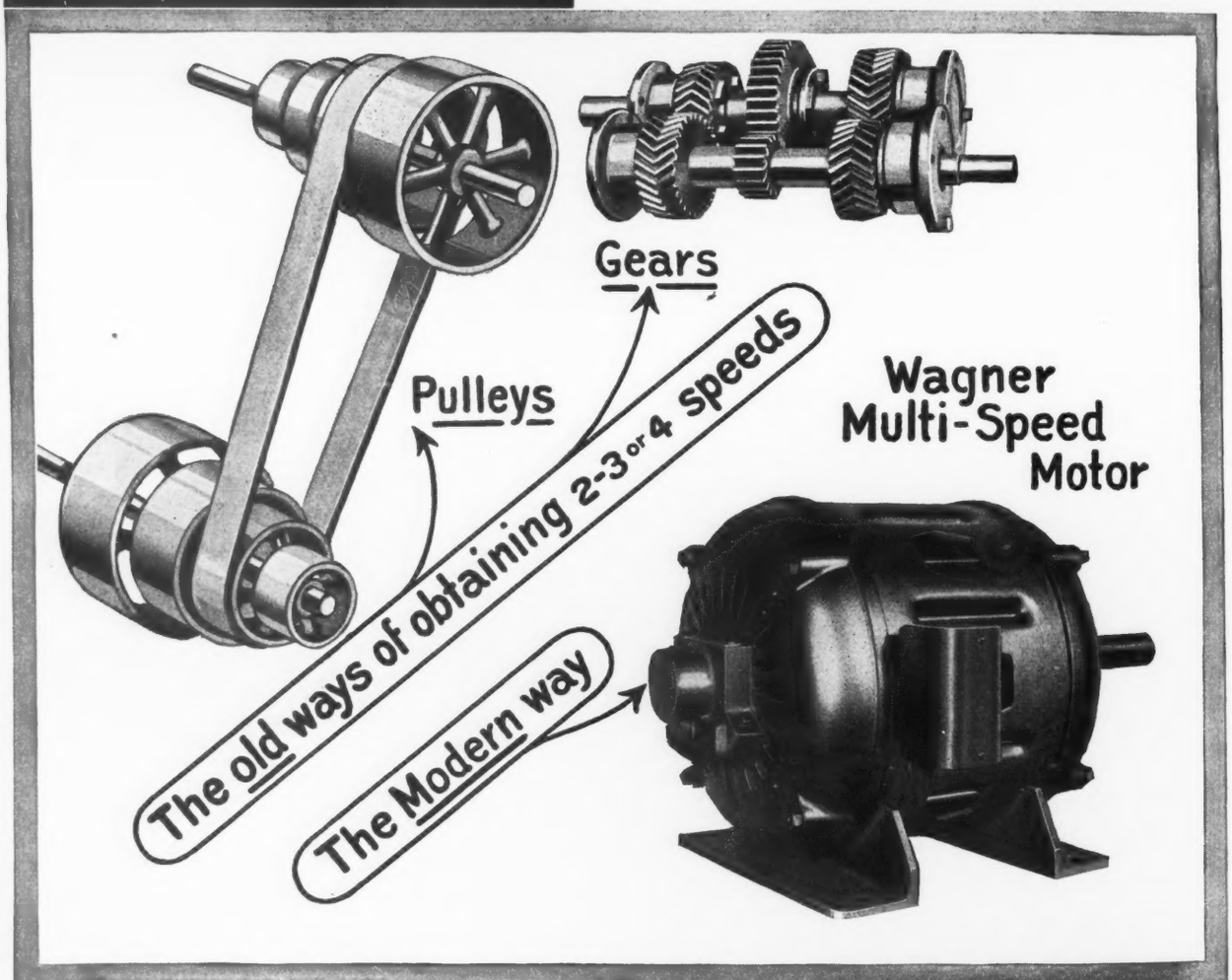
JOIN US IN THE GENERAL ELECTRIC PROGRAM, BROADCAST EVERY SATURDAY EVENING ON A NATION-WIDE N.B.C. NETWORK

GENERAL ELECTRIC

SALES AND ENGINEERING SERVICE IN PRINCIPAL CITIES

Multi-speed motors vs. gears, pulleys and belts

Gears, pulleys and belts are indispensable for power transmission—but there is no longer any need of their being utilized for speed variations. » » » With the development of multi-speed motors, many speed variations are obtainable without the use of auxiliary equipment. Just one item is involved: the multi-speed motor—compact, easy to install, long-lived, requiring no more maintenance than ordinary one-speed motors—no complicated gear reduction units which might become objectionable because of vibration and noise (and also because of larger size and additional maintenance cost)—no maze of pulleys and belts on lathes and other machine tools—just the motor itself, operating silently and smoothly, furnishing a second, a third or a fourth speed instantly, without fuss or trouble, automatically if necessary. » » » There are many advantages of applying multi-speed



motors instead of resorting to other devices for obtaining different operating speeds. The subject is too large to discuss fully in a single advertisement. Investigate! Authorize us to send our nearest sales-engineer to discuss the subject fully. The coupon is for your convenience.

WAGNER ELECTRIC CORPORATION
6400 Plymouth Ave., St. Louis, Mo.

☐ Please send literature on multi-speed motors.
☐ Have Wagner salesman call.

Name and Position

Company

Address

Wagner
Electric Corporation
6400 Plymouth Avenue, Saint Louis, U. S. A.

MOTORS TRANSFORMERS FANS
LOCKHEED HYDRAULIC BRAKES

L231-5XA

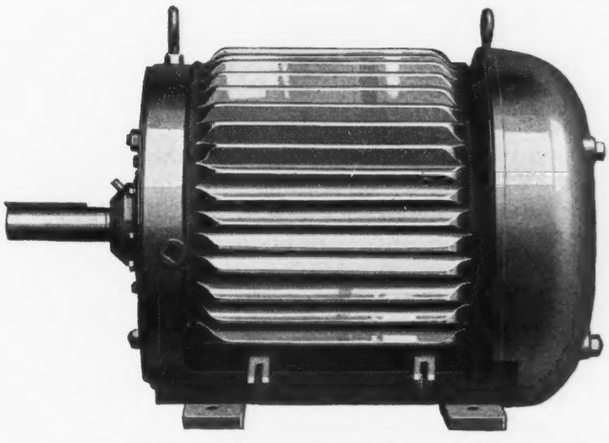
Got any water ?

Got any gas ?

Got any dust ?

"Why the interrogations?"

"Well, these things in the plant play hob with bearings and windings of ordinary motors. But they can't attack the new stainless steel 'Linc-Weld' totally enclosed fan cooled motor because its working parts are completely sealed."

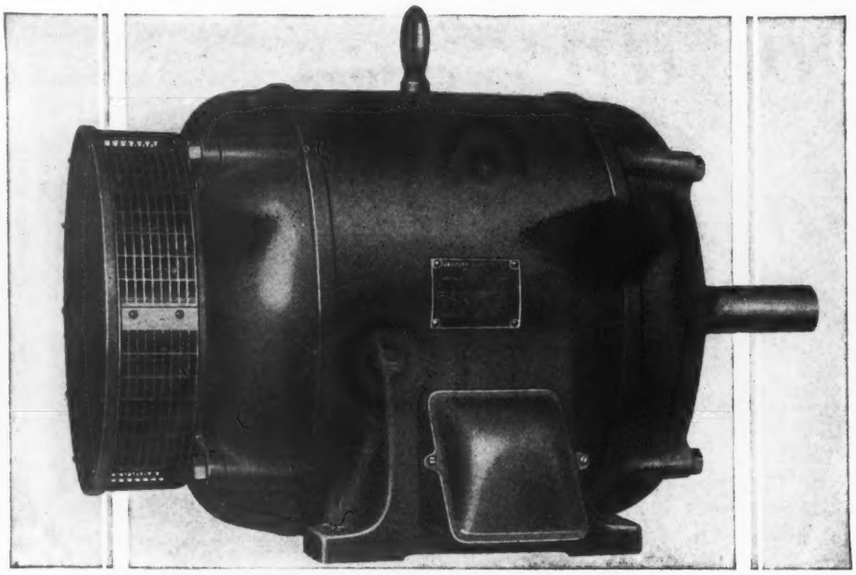


"Linc-Weld" totally enclosed fan cooled motor with cover removed showing the completely sealed unit.

THE LINCOLN
ELECTRIC COMPANY . . Cleveland, Ohio

M-88

THEY KEEP A-RUNNING



10 Horse Power Century Type SC Multi-speed Constant Torque Squirrel Cage Induction 3 Phase Motor

Totally Enclosed Fan Cooled MULTI-SPEED MOTORS

Constant Horse Power — Constant Torque — Variable Torque

These Multi-speed Squirrel Cage Motors are especially suitable for operating fans, blowers, stokers and other equipment where adjustable speed requirements must be met. They are built in 2, 3 and 4 speeds, with wide or narrow speed ranges—such as 1800/1200 or 1800/600 down to 900/450 R.P.M. (60 cycle). Special speed combinations are also available.

Their Totally Enclosed Fan Cooled construction gives the added advantage of full protection to the windings, armature and other internal parts of the motor when operated in surroundings where dust, dirt, dampness and fumes are present in objectionable quantities. Operating continuity is thus assured in hard service applications.

Built in standard sizes up to 150 horse power in normal torque and normal or low starting current types.

CENTURY ELECTRIC COMPANY

1806 PINE ST. • • ST. LOUIS, MO.

40 U.S. and Canadian Stock Points and More Than 75 Outside Thereof

SINGLE PHASE, THREE PHASE, AND DIRECT CURRENT MOTORS

Century MOTORS

MOTOR GENERATOR SETS, ROTARY CONVERTORS, FANS AND VENTILATORS

MS-I-IO

FOR MORE THAN 27 YEARS AT ST. LOUIS

FAVORITES
throughout the MECHANICAL INDUSTRIES

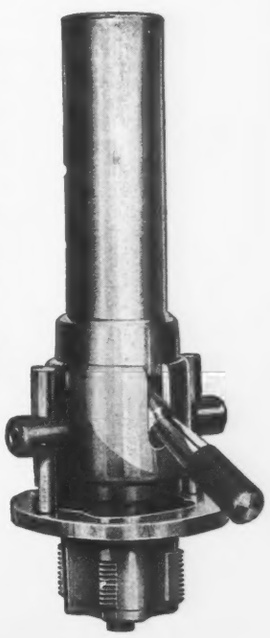
Murchey Collapsible Taps and Self-Opening Die Heads are well represented in the country's leading shops—automotive, aviation, railroad and many others. They are favorites throughout the mechanical industries because their dependability is unquestioned.

Your most modern machines are inefficient without modern tools. Murchey tools are thoroughly modern in design and construction—a fitting complement to the finest equipment.

59 Sizes of Taps
42 Sizes of Die Heads

Murchey manufactures a complete line of taps and die heads to cover a wide range of work. They are rugged and compact—built of hardened ground steel for accuracy and long service. Standardize on Murchey—it's profitable!

With Murchey Tools you can maintain accurate thread lengths at top speeds, cut down on time and labor expended, and produce faster. Wide interchangeability of parts is another feature that should not be overlooked, for it reduces tool expense. Write today for full details—and send blue prints of your threading operations for tool recommendations.



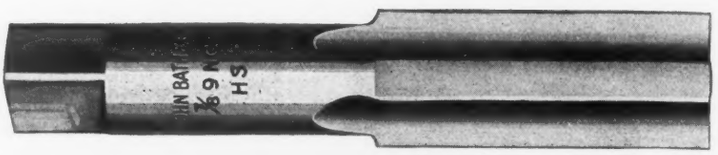
The MURCHEY MACHINE & TOOL CO.
951 PORTER ST., DETROIT, MICH.

Foreign Agents: Coats Machine Tool Company, Ltd., 14 Palmer Street, Westminster, London, S.W.1, England; Henri Aelion & Company, 35 Rue Lantiez, Paris, France.

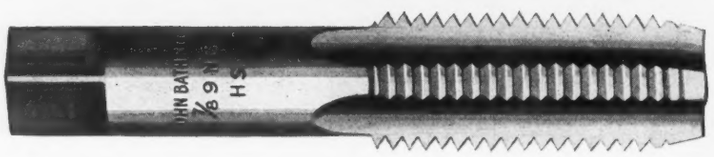
MURCHEY

BATH "Grinds Threads from the solid"

Hardened in the Solid



Thread Ground from the Solid



Grinding from the solid is a distinctive feature of Bath ground thread taps. The process results in a refined steel structure on the cutting edges of the teeth not possible by any other process. Metallurgists agree that Bath taps are given an ideal heat treatment from the standpoint of wearing qualities and long service life. Bath taps produce more tapped holes per dollar of tool cost.

JOHN BATH & CO. INC.
Worcester, Mass.

Here's Your Equipment for 400% Faster Boring

You can bore to the full speed capacity of your boring machine if Madison Boring Bars are on the job, because these tools never overheat and score the work. Their adoption has increased production by as much as 400% in many shops — and they're as accurate as they are fast.

Madison Boring Bars are adjustable to .00025, and have floating cutters that compensate for any misalignment.

Circulars on request.

MADISON MFG. CO.
Muskegon, Michigan

OSGOOD'S
DIAMOND TOOLS AND FILE ACCESSORIES

HIGH GRADE DIAMOND TOOLS for all purposes.
OSGOOD FILEGRIPS—rubber tips that protect hands.
OSGOOD INDESTRUCTIBLE FILE HANDLES can't split or come off.

Write for bulletins

J. L. Osgood Machinery & Tool Co., Inc.
43-45 Pearl St., Buffalo, N. Y.

GROBET SWISS FILES

Standard of excellence for more than a hundred years.
Write for our Catalog A

GROBET FILE CORPORATION OF AMERICA
3 Park Place **New York City**

Red Shield High Speed Drills

ALL SIZES

THE STANDARD TOOL CO.
NEW YORK CLEVELAND CHICAGO

Your Dollar's Worth of *Chips!*

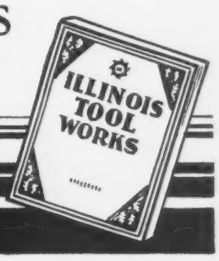
ARE your operation costs yielding their full quota of dividends? When you spend milling machine operating dollars, the return is largely dependent upon the milling cutters used. Do they give maximum performance? Do you get lowest unit costs? The measure for this is Illinois High Speed Milling Cutters.

Illinois Cutters are designed and made to cut production costs.

The Illinois Tool Works 256 page Catalog "D" and supplement on Inserted Blade Cutters will be sent upon request.

"Buy 'Illinois' Metallurgy in your tools"

ILLINOIS TOOL WORKS
2501 N. Keeler Ave., Chicago Illinois



ILLINOIS
HIGH SPEED STEEL
TOOLS

CARD
GROUND THREAD TAPS
Prove An Axiom

It is axiomatic that you cannot expect to do good work with poor tools. Card Ground Thread Taps prove that you do best work with best tools.

It would be hard to buy better taps than these Card products. It is significant that critical buyers select them for important jobs.

Card Ground Thread Taps—produced by specialists (we have been tap makers since 1874), in an especially equipped plant—represent the acme of threading quality and economy.

Send for size and price list of Card Ground Thread Taps in High Speed or Carbon Steel

S. W. CARD MANUFACTURING CO.
MANSFIELD, MASS., U. S. A.
DIVISION OF UNION TWIST DRILL COMPANY

Time Saved
Money Earned

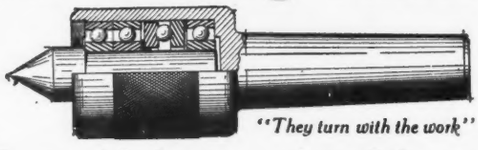
GAMMONS TAPER PIN REAMERS

This Gammons Taper Pin Reamer reams this job in *2 minutes*, just one-tenth of the time required by former methods. Saving *18 minutes* on one small job is just an indication of the way in which G-H production tools help earn added profits on a wide range of work.

Send for details of the Gammons Taper Pin Reamer and the entire G-H Line.

THE GAMMONS-HOLMAN CO.
MANCHESTER Dept. M. CONN.
Originators of Helical Fluted Taper Pin Reamers

"ALIVE" Ball Bearing Centers



"They turn with the work"

will not stick, burn or enlarge hole centers even at highest speeds. The hardened, ground points never require regrinding.

Write for price list.

MODERN MACHINE CORPORATION
285-287 North 6th Street BROOKLYN, N. Y.

RED-LINE EXPANSION REAMER with ROUGHING PILOT END
Rough reams and finishes undersized bushings in one operation.
RED-LINE REAMER COMPANY, Dept. M., Millersburg, Pennsylvania

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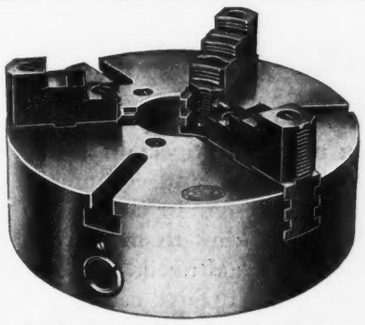

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No. 179 Iron Heavy Geared Scroll Universal. No. S179 Steel, 4 to 32 inches with reversible Top jaws.

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A chuck is only a comparatively small machine tool accessory—and yet the production efficiency of the machine, the quality of the work may be completely ruined unless you get the right chuck—the correct type, size and quality.

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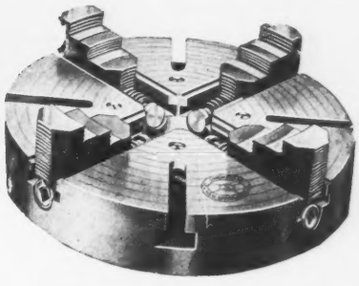

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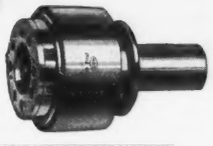

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For Non-Reversing Drills

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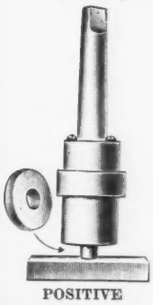

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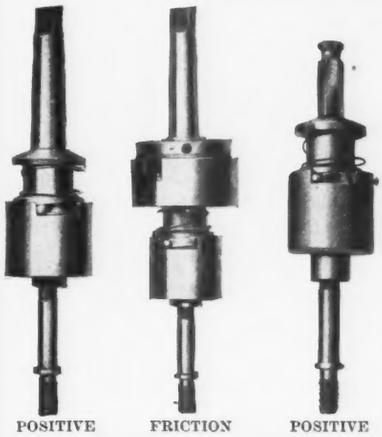

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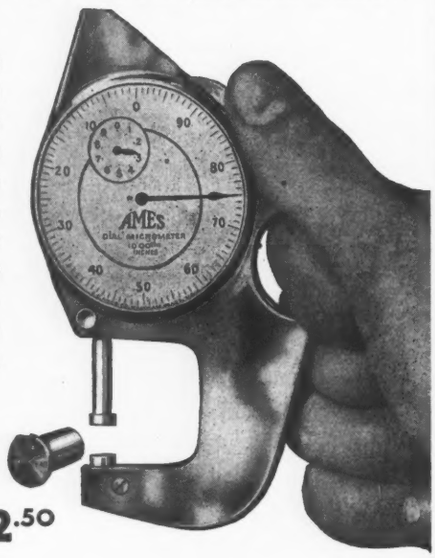

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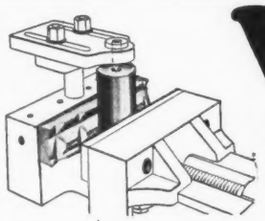

Fig. 3. V-Jaw for Round Work

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Jaws 6", 9" and 12" Long
Flanged around bottom for bolting down, with three slots at large end, not shown.

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Fig. 2. Without Jig Attachments

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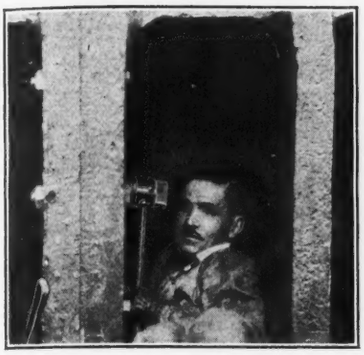

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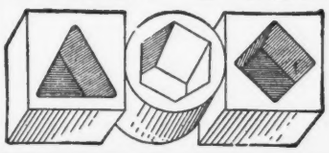

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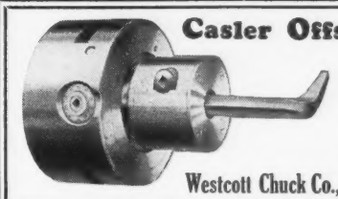

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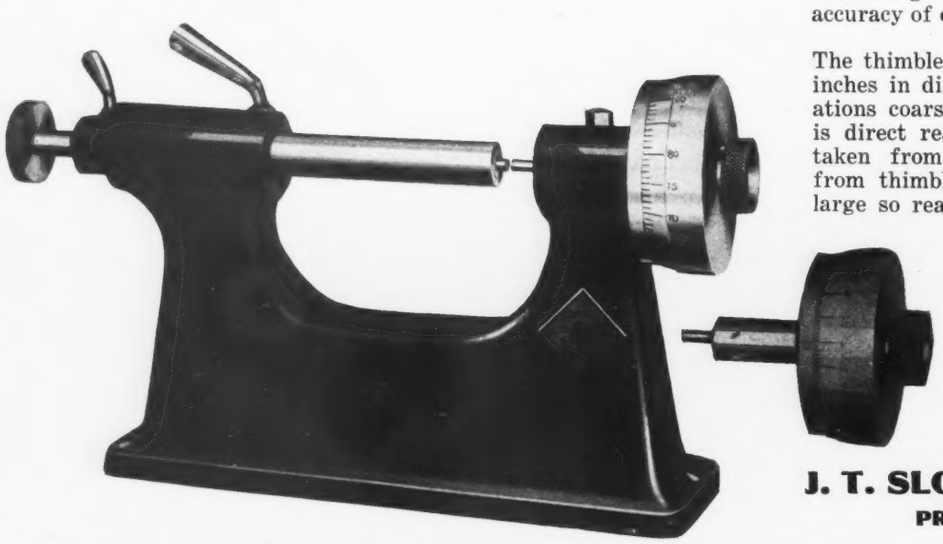

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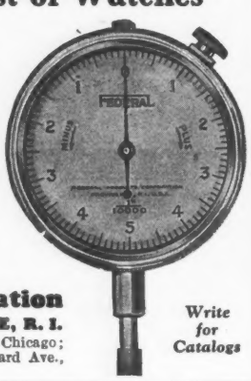

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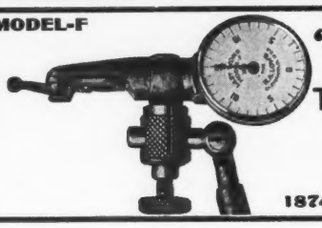

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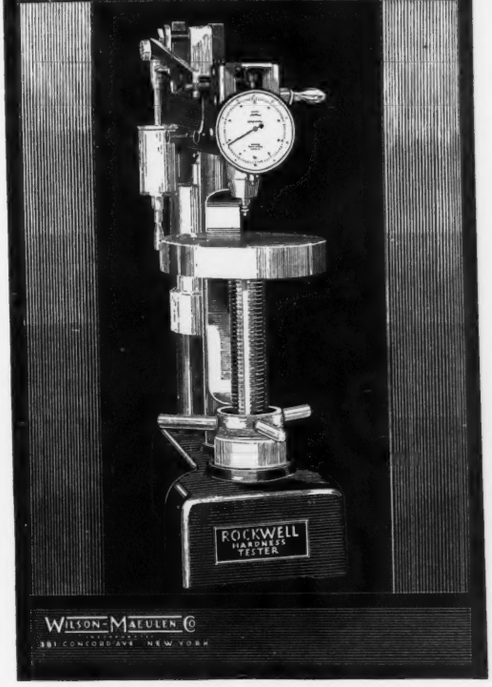

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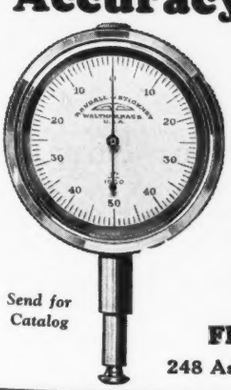

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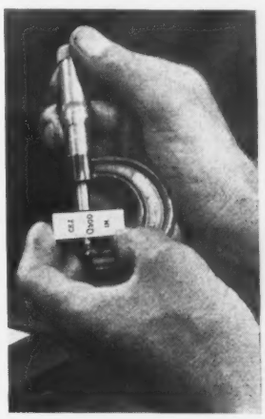

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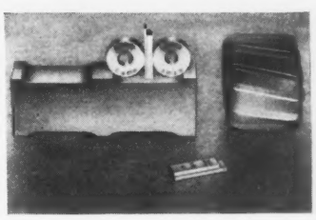

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48" Colburn, Two Swivel Heads.
12' Niles, Vertical, 2 heads.
No. 32 Giddings & Lewis Horiz.

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16" & 20" Stockbridge, Motor Driven.
36"x36"x10' Gray, 2 heads.

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No. 2 & 3 Cinti. H.P. Plain, SPD; flange nose.
No. 2 Cincinnati H.P. Univ. SPD flange nose.
No. 3 Cincinnati H.P. Vert. S.P.D.
No. 3-B Milwaukee Pl. Dbl. overarm, late type.
18" Cincinnati Auto. Miller, M.D.
24" Cincinnati Auto. Miller, M.D.
No. 33 Kempsmith Auto. Miller.

GRINDERS

No. 1 Diamond Surface Grinder.
No. 11 Brown & Sharpe Plain Grinder.
16"x68" Landis Self Cont. Crankshaft Grinder.
10"x52" Landis Self Contained.
6"x18" Landis, Self Contained.

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Wickes Punch & Shear, 48" throat, 1¼" thru 1¼.
1½" Landis Bolt Cutter, Grd. Hd. M.D.
2" Landis Bolt Cutter, lead screw attachment.
No. 4 Warner-Swasey Universal Turret Lathe.
No. 1-B Foster Universal Turret Lathe, M.D.
No. 56 Adriance Dbl. Crank Str. Side Press.
No. 76 Toledo Open Back Gap Frame Press.
No. 2-A Warner & Swasey Univ. Turret Lathes.
No. 94 Ferracute Dbl. Cr. Press.
No. 76 Toledo Str. Sd. Open Back Press.

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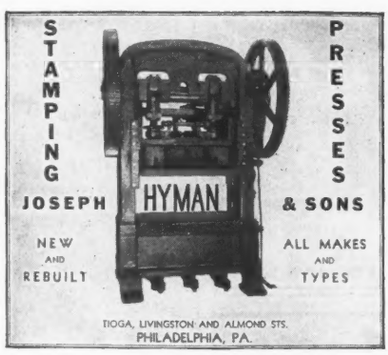

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LATHES, TURRET. 24" & 36" Bullard.
MILL, BORING. 60" Colburn.
MILL, HORIZ. No. 6 Defiance, 4½" bar.
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MILLERS, Univ. Nos. 2 & 3 Kempsmith.
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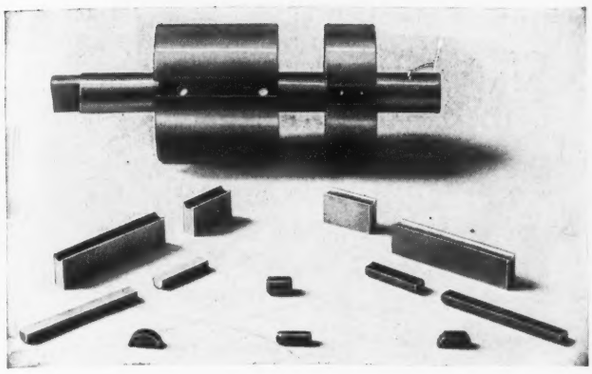

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FOR LOCATION OF ADVERTISEMENTS OF MANUFACTURERS LISTED IN THIS INDEX SEE ALPHABETICAL INDEX, PAGES 201-202

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Watson-Stillman Co., 107 Aldene Road, Roselle, N. J.

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Hunt, C. B., & Son, Salem, Ohio

AIR HOISTS
See Hoists, Air.

AIR TOOLS
See Grinders, Pneumatic; Drills, Portable Pneumatic, etc.

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Waterbury Steel Ball Co., Inc., Poughkeepsie, N. Y.

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See Boring Bars.

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Buckeye Brass & Mfg. Co., Cleveland.

BARS, STEEL
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Norma-Hoffmann Bearings Corp., Stamford, Conn.
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Watson-Stillman Co., 107 Aldene Road, Roselle, N. J.

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Canedy-Otto Mfg. Co., Chicago Heights, Ill.
General Electric Co., Schenectady, N. Y.
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BLUEPRINTS FILING CABINETS
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National Machinery Co., Tiffin, O.

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Rockford Drilling Mch. Co., Rockford, Ill.
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Lovejoy Tool Co., Inc., Springfield, Vt.
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Barber-Colman Co., Rockford, Ill.
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Jarvis, Chas. L., Co., Gildersleeve, Conn.
Modern Tool Works (Consolidated Mch. Tool Corp.) Rochester, N. Y.
Watts Bros. Tool Wks., Wilmerding, Pa.

CLAMPS
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Danly Mch. Specialties, Inc., 2112 S. 52nd Ave., Chicago.
Starrett, L. S., Co., Athol, Mass.
Williams, J. H., & Co., 75 Spring St., New York City.

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CLEANSERS, CHEMICAL, FOR WASTE AND METAL
Oakite Products, Inc., 26 Thames St., New York.

CLEANING COMPOUND
See Compound, Cleaning.

CLUTCHES, FRICTION, ETC.
Brown Engineering Co., 133 N. Third St., Reading, Pa.
Conway Clutch Co., 1547 Queen City Ave., Cincinnati.
Farrel-Birmingham Co., Inc., 377 Vulcan St., Buffalo, N. Y.
Foote Bros. Gear & Machine Co., Dept. 37, 215 N. Curtis St., Chicago, Ill.
Johnson, Carlyle, Mch. Co., Manchester, Conn.
Production Mch. Co., Greenfield, Mass.
Rockford Drilling Mch. Co., Rockford, Ill.

COLLARS, SAFETY
Bridgeport Safety Emery Wheel Co., Inc., 1283 W. Broad St., Bridgeport, Ct.
Standard Pressed Steel Co., Jenkintown, Pa.

COLLARS, SPACING, ETC.
Detroit Stamping Co., Detroit, Mich.

COLLETS
Ames Co., B. C., Waltham, Mass.
Brown & Sharpe Mfg. Co., Providence.
Cleveland Twist Drill Co., Cleveland.
Geometric Tool Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland.
Union Twist Drill Co., Athol, Mass.

COLLETS, SPRING
Hardinge Bros., Inc., 4149 Ravenswood Ave., Chicago.
Stark Tool Co., Waltham, Mass.

COMPARATORS, SCREW THREAD
Bausch & Lomb Optical Co., 619 St. Paul St., Rochester, N. Y.
Ferner, R. Y., Co., Washington, D. C.
Jones & Lamson Mch. Co., Springfield, Vt.

COMPOUND, CLEANING
Oakite Products, Inc., 26 Thames St., New York.

COMPOUND, CUTTING, GRINDING, ETC.
Oakite Products, Inc., 26 Thames St., New York.

COMPRESSORS, AIR
Brunner Mfg. Co., Utica, N. Y.
General Electric Co., Schenectady, N. Y.

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American Die & Tool Co., Reading, Pa.
American Tool & Mfg. Co., Urbana, O.
Automatic Machine Co., Bridgeport, Ct.
Bliss, E. W., Co., Brooklyn, N. Y.
City Mch. & Tool Wks., Dayton, O.
Columbus Die, Tool & Mch. Co., Columbus, O.
Diefendorf Gear Corp., Syracuse, N. Y.
Hartford Special Mchy. Co., Hartford.
Hoefer Mfg. Co., Freeport, Ill.
Illinois Tool Works, 2501 N. Keeler Ave., Chicago.
Johnson, Carlyle, Machine Co., Manchester, Conn.
LeBlond, R. K., Mch. Tool Co., Cincinnati.
Meisel Press Mfg. Co., 948 Dorchester Ave., Boston 25, Mass.
Minster Machine Co., Minster, O.
Modern Machine Corp., 285 N. 6th St., Brooklyn, N. Y.
Modern Tool Works (Consolidated Mch. Tool Corp.) Rochester, N. Y.
Mummert-Dixon Co., Hanover, Pa.
National Acme Co., Cleveland.
New Britain-Gridley Mch. Co., New Britain, Conn.
Niles Tool Works Co., Hamilton, Ohio.
Pratt & Whitney Co., Hartford, Conn.
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Ruthman Machinery Co., 530 E. Front St., Cincinnati, O.
Taylor-Shantz Co., Rochester, N. Y.
U. S. Tool Co., Inc., Ampere, N. J.
V & O Press Co., Hudson, N. Y.

CONTROLLERS
Allen-Bradley Co., 1331 S. First St., Milwaukee, Wis.
Cutler-Hammer, Inc., 1204 St. Paul Ave., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.

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Illinois Tool Works, 2501 N. Keeler Ave., Chicago.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Tool Co., Cleveland.
Pratt & Whitney Co., Hartford, Conn.
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Starrett, L. S., Co., Athol, Mass.
Union Twist Drill Co., Athol, Mass.

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Union Twist Drill Co., Athol, Mass.

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Veeder-Root, Inc., Hartford, Conn.

COUNTING DEVICES
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Greene, Tweed & Co., 109 Duane St., New York.

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Johnson, Carlyle Mch. Co., Manchester, Conn.

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Brown Engineering Co., 133 N. Third St., Reading, Pa.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Falk Corp., Milwaukee, Wis.
Foote Bros. Gear & Machine Co., Dept. 37, 215 N. Curtis St., Chicago, Ill.
Philadelphia Gear Works, Philadelphia.
Poole Engineering & Machine Co., Baltimore, Md.

COUPLINGS, SHAFT
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Brown Engineering Co., 133 N. Third St., Reading, Pa.
Foote Bros. Gear & Machine Co., Dept. 37, 215 N. Curtis St., Chicago, Ill.
Johnson, Carlyle, Machine Co., Manchester, Conn.
Sellers, Wm., & Co., Inc., Philadelphia.
Smith, Winfield H., Inc., 116 Eaton St., Springville, N. Y.

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Roeper Crane & Hoist Wks., Reading, Pa.

CRANES, HAND TRAVELING
Roeper Crane & Hoist Wks., Reading, Pa.

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Canedy-Otto Mfg. Co., Chicago Heights, Ill.
Canton Fdry. & Mch. Co., Canton, O.

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Lodge & Shipley Mch. Tool Co., Cincinnati.
Niles Tool Works Co., Hamilton, O.
Pedrick Tool & Mch. Co., 3639 N. Lawrence St., Philadelphia.

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Brown & Sharpe Mfg. Co., Providence.
National Tool Co., Cleveland.
O. K. Tool Co., Shelton, Conn.
Standard Tool Co., Cleveland.
Union Twist Drill Co., Athol, Mass.

CUTTERS, MILLING
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Brown & Sharpe Mfg. Co., Providence.
Cleveland Twist Drill Co., Cleveland.
Colonial Broach Co., Detroit.
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Consolidated Mch. Tool Corp. of America, Rochester, N. Y.
Cowles Tool Co., Cleveland.
Gammons-Holman Co., Manchester, Ct.
Gorton, Geo., Mch. Co., 1109 13th St., Racine, Wis.
Illinois Tool Works, 2501 N. Keeler Ave., Chicago.
Ingersoll Milling Mch. Co., Rockford, Ill.
Kearney & Trecker Corp., Milwaukee, Wis.
Lovejoy Tool Co., Inc., Springfield, Vt.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Tool Co., Cleveland.
Newark Gear Cutting Mch. Co., Newark, N. J.
O. K. Tool Co., Inc., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.
Reed-Prentice Corp., Worcester, Mass.
Standard Tool Co., Cleveland.
Union Twist Drill Co., Athol, Mass.
Whitney Mfg. Co., Hartford, Conn.

CUTTING COMPOUND
See Compound, Cutting, Grinding, etc.

CUTTING-OFF MACHINES, ABRASIVE WHEEL
Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago.
Cincinnati Electrical Tool Co., Cincinnati, Ohio.

CUTTING-OFF MACHINES, COLD SAW
See Sawing Machines, Circular.

CUTTING-OFF MACHINES
Automatic Machine Co., Bridgeport, Ct.
Avey Drilling Mch. Co., Cincinnati.
Bardons & Oliver, Cleveland.
Brown & Sharpe Mfg. Co., Providence.
Curtis & Curtis, 324 Garden St., Bridgeport, Conn.
Gorton, Geo., Mch. Co., 1109 13th St., Racine, Wis.
Hurlbut-Rogers Mchry. Co., Nashua, N. H.
Landis Mch. Co., Inc., Waynesboro, Pa.

CUTTING-OFF MACHINES, ROTARY
Etna Machine Co., Toledo, Ohio.

CUTTING-OFF TOOLS
Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago.
O. K. Tool Co., Inc., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.
Ready Tool Co., Bridgeport, Conn.
Williams, J. H., & Co., 75 Spring St., New York City.

CYLINDER BORING MACHINES
Baker Bros., Inc., Toledo, O.
Consolidated Mch. Tool Corp. of America, Rochester, N. Y.
Ingersoll Milling Mch. Co., Rockford, Ill.
Manning, Maxwell & Moore, Inc., 100 E. 42nd St., New York.
Modern Tool Works (Consolidated Mch. Tool Corp.) Rochester, N. Y.
Niles Tool Works Co., Hamilton, O.
Sellers, Wm., & Co., Inc., Philadelphia.

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Pedrick Tool & Mch. Co., 3639 N. Lawrence St., Philadelphia.

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Eastern Machinery Co., Cincinnati.
General Mchry. Corp., Boston, Mass.
Miles Machinery Co., Saginaw, Mich.
Osborne & Sexton Mchry. Co., Columbus, O.
Osgood, J. L., Mchy. & Tool Co., Inc., Buffalo, N. Y.
Ryerson, Joseph T., & Son, 2558 W. 16th St., Chicago.

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Heald Machine Co., Worcester, Mass.
J. & H. Electric Co., Providence, R. I.
Walker, O. S., Co., Inc., Worcester, Mass.

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Madison-Kipp Corp., Madison, Wis.
Reed Prentice Corp., Worcester, Mass.

DIE CASTINGS
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U. S. Tool Co., Inc., Ampere, N. J.

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Gorton, Geo., Mch. Co., 1109 13th St., Racine, Wis.
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Reed-Prentice Corp., Worcester, Mass.

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See Stocks, Die.

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Columbus Die, Tool & Mch. Co., Columbus, O.
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Toledo Mch. & Tool Co., Toledo, O.
Tomkins-Johnson Co., Jackson, Mich.
U. S. Tool Co., Inc., Ampere, N. J.
V. & O. Press Co., Hudson, N. Y.
Waltham Mch. Wks., Waltham, Mass.

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Card, S. W., Mfg. Co., Div. of Union Twist Drill Co., Mansfield, Mass.
Geometric Tool Co., New Haven, Conn.
Greenfield Tap & Die Corporation, Greenfield, Mass.
Hardinge Bros., Inc., 4149 Ravenswood Ave., Chicago.
Jones & Lamson Mch. Co. Springfield, Vt.
Landis Mch. Co., Inc., Waynesboro, Pa.
Modern Tool Works (Consolidated Mch. Tool Corp.) Rochester, N. Y.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Acme Co., Cleveland.
Pratt & Whitney Co., Hartford, Conn.
Ruthman Machinery Co., 530 E. Front St., Cincinnati, O.
Standard Tool Co., Cleveland.

DIES, THREADING, OPENING
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Eastern Mch. Screw Corp., New Haven.
Errington Mechanical Laboratory, 200 Broadway, New York.
Geometric Tool Co., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Landis Mch. Co., Inc., Waynesboro, Pa.
Murchey Mch. & Tool Co., 951 Porter St. Detroit.
National Acme Co., Cleveland.

DIES, THREADS, ROLLING
Hanson-Whitney Mch. Co., Hartford, Ct.

DISCS, ABRASIVE
Carborundum Co., Niagara Falls, N. Y.
Walls Sales Corp., 96 Warren St., N. Y.

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LeBlond, R. K., Mch. Tool Co., Cincinnati.
See also Milling Machines, Horizontal, Universal.

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Danly Mch. Specialties, Inc., 2112 S. 52nd Ave., Chicago.

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Hamilton Mfg. Co., Two Rivers, Wis.
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Universal Drafting Mch. Co., Cleveland.

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Pease, C. F., Co., 822 No. Franklin St., Chicago, Ill.

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Calder Co., Geo., H., Lancaster, Pa.
Desmond-Stephan Mfg. Co., Urbana, O.
Norton Co., Worcester, Mass.
Standard Tool Co., Cleveland.

DRIFTS, DRILL
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Standard Tool Co., Cleveland, O.
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Cincinnati Electrical Tool Co., Cincinnati, Ohio.
Cleveland Twist Drill Co., Cleveland.
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Standard Tool Co., Cleveland, O.
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Waterstons, 423 Woodward Ave., Detroit

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Dumore Co., 25 16th St., Racine, Wis.
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Leland-Gifford Co., Worcester, Mass.
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Rockford Drilling Mch. Co., Rockford, Ill.
Sigourney Tool Co., 11 Sigourney St., Hartford, Conn.
Superior Mch. Tool Co., Kokomo, Ind.
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Foote-Burt Co., Cleveland, O.
Niles Tool Works Co., Hamilton, Ohio.
Sellers, Wm., & Co., Inc., Philadelphia.

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Barnes Drill Co., 814 Chestnut St., Rockford, Ill.
Barnes, W. F. & John, Co., Rockford, Ill.
Canedy-Otto Mfg. Co., Chicago Heights, Ill.
Cincinnati Bickford Tool Co., Oakley, Cincinnati.
Consolidated Mch. Tool Corp. of America, Rochester, N. Y.
Foote-Burt Co., Cleveland, O.
Hoefer Mfg. Co., Freeport, Ill.
Ingersoll Milling Mch. Co., Rockford, Ill.
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Millholland Sales & Engineering Co., Indianapolis, Ind.
Moline Tool Co., Moline, Ill.
Niles Tool Works Co., Hamilton, Ohio.
Rockford Drilling Mch. Co., Rockford, Ill.
Sigourney Tool Co., 11 Sigourney St., Hartford, Conn.
Superior Mch. Tool Co., Kokomo, Ind.

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Frew Machine Co., Philadelphia.
Kingsbury Mch. Tool Corp., Keene, N. H.
Millholland Sales & Engineering Co., Indianapolis, Ind.
Murchey Mch. & Tool Co., 951 Porter St., Detroit.
Rockford Drilling Mch. Co., Rockford, Ill.

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Barnes, W. F. & John, Co., Rockford, Ill.
Canedy-Otto Mfg. Co., Chicago Heights, Ill.
Cincinnati Bickford Tool Co., Oakley, Cincinnati.
Consolidated Mch. Tool Corp. of America, Rochester, N. Y.
Foote-Burt Co., Cleveland, O.
Conn.
Greenlee Bros. & Co., Rockford, Ill.
Hoefer Mfg. Co., Freeport, Ill.
Ingersoll Milling Mch. Co., Rockford, Ill.
Kingsbury Mch. Tool Corp., Keene, N. H.
Leland-Gifford Co., Worcester, Mass.
Millholland Sales & Engineering Co., Indianapolis, Ind.
Moline Tool Co., Moline, Ill.
Niles Tool Works Co., Hamilton, Ohio.
Pratt & Whitney Co., Hartford, Conn.
Rockford Drilling Mch. Co., Rockford, Ill.
Sellers, Wm., & Co., Inc., Philadelphia.
Superior Mch. Tool Co., Kokomo, Ind.
United States Drill Head Co., Cincinnati.

DRILLING MACHINES, MULTIPLE SPINDLE, TURRET
Kingsbury Mch. Tool Corp., Keene, N. H.

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Canedy-Otto Mfg. Co., Chicago Heights, Ill.
Carlton Mch. Tool Co., Cincinnati.
Cincinnati Bickford Tool Co., Oakley, Cincinnati.
Dreses Mch. Tool Co., Cincinnati.
Morris Mch. Tool Co., Cincinnati.
Niles Tool Works Co., Hamilton, O.
Ryerson, Joseph T., & Son, 2558 W. 16th St., Chicago.
Sellers, Wm., & Co., Inc., Philadelphia.
Western Mch. Tool Wks., Holland, Mich.

DRILLING MACHINES, RAIL
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Consolidated Mch. Tool Corp. of America, Rochester, N. Y.
Defiance Machine Co., Defiance, O.
Foote-Burt Co., Cleveland, O.
General Electric Co., Schenectady, N. Y.
Moline Tool Co., Moline, Ill.
Sellers, Wm., & Co., Inc., Philadelphia.

DRILLING MACHINES, SENSITIVE
Avey Drilling Mch. Co., Cincinnati.
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Burke Mch. Tool Co., 516 Sandusky St., Conneaut, O.
Canedy-Otto Mfg. Co., Chicago Heights, Ill.
Foote-Burt Co., Cleveland, O.
High Speed Hammer Co., Inc., Rochester, N. Y.
Kingsbury Mch. Tool Corp., Keene, N. H.
Leiman Bros., 152 Christie St., Newark, N. J.
Leland-Gifford Co., Worcester, Mass.
Manufacturers' Consulting Engineers, Syracuse, N. Y.
Moline Tool Co., Moline, Ill.
Pratt & Whitney Co., Hartford, Conn.
Rockford Drilling Mch. Co., Rockford, Ill.
Sibley Mch. Co., 8 Tutt St., South Bend, Ind.
Sigourney Tool Co., 11 Sigourney St., Hartford, Conn.
United States Mch. Tool Co., 1950 W. 6th St., Cincinnati.

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Avey Drilling Mch. Co., Cincinnati.
Baker Bros., Inc., Toledo, O.
Barnes, W. F. & John, Co., Rockford, Ill.
Canedy-Otto Mfg. Co., Chicago Heights, Ill.
Cincinnati Bickford Tool Co., Oakley, Cincinnati.
Consolidated Mch. Tool Corp. of America, Rochester, N. Y.
Foote-Burt Co., Cleveland, O.
Hoefer Mfg. Co., Freeport, Ill.
Ingersoll Milling Mch. Co., Rockford, Ill.
Kingsbury Mch. Tool Corp., Keene, N. H.
Leland-Gifford Co., Worcester, Mass.
Millholland Sales & Engineering Co., Indianapolis, Ind.
Minster Machine Co., Minster, O.
Moline Tool Corp., Moline, Ill.
Rockford Drilling Mch. Co., Rockford, Ill.
Superior Mch. Tool Co., Kokomo, Ind.

DRILLING MACHINES, WALL RADIAL
Canedy-Otto Mfg. Co., Chicago Heights, Ill.
Consolidated Mch. Tool Corp. of America, Rochester, N. Y.
Wickes Bros., Saginaw, Mich.

DRILLS, CENTER
Cleveland Twist Drill Co., Cleveland.
Cogsdill Mfg. Co., Detroit, Mich.
Greenfield Tap & Die Corporation, Greenfield, Mass.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Providence, R. I.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.

DRILLS, CORE
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Union Twist Drill Co., Athol, Mass.

DRILLS, PORTABLE ELECTRIC
Black & Decker-Van Dorn, Towson, Md.
Cincinnati Electrical Tool Co., Cincinnati, Ohio.
Dumore Co., 25 16th St., Racine, Wis.
Errington Mechanical Laboratory, 200 Broadway, New York.
Haskins, R. G., Co., 4634 Fulton St., Chicago.
Independent Pneumatic Tool Co., 606 W. Jackson Blvd., Chicago.
Standard Electrical Tool Co., 1936 W. 8th St., Cincinnati.
U. S. Electrical Tool Co., Cincinnati.
White, S. S., Dental Mfg. Co., 150 W. 42nd St., N. Y.

DRILLS, PORTABLE PNEUMATIC
Independent Pneumatic Tool Co., 606 W. Jackson Blvd., Chicago.

DRILLS, RATCHET
Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago.
Cleveland Twist Drill Co., Cleveland.
Greene, Tweed & Co., 109 Duane St., New York.
Greenfield Tap & Die Corporation, Greenfield, Mass.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.

DRILLS, SQUARE AND HEXAGON
Watts Bros. Tool Wks., Wilmerding, Pa.

DRILLS, TWIST
Cleveland Twist Drill Co., Cleveland.
Colton, Arthur, Co., 2618 Jefferson Ave., E., Detroit, Mich.
Greenfield Tap & Die Corporation, Greenfield, Mass.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Red-Line Reamer Co., Millersburg, Pa.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.

DRILLS, WIRE
Cogsdill Mfg. Co., Detroit, Mich.
Union Twist Drill Co., Athol, Mass.

DRIVE SCREWS
Parker-Kalon Corp., 200 Varick St., New York.

DRYING MACHINES, METAL PARTS
Colt's Patent Fire Arms Mfg. Co., Hartford, Conn.

ELECTRICAL EQUIPMENT
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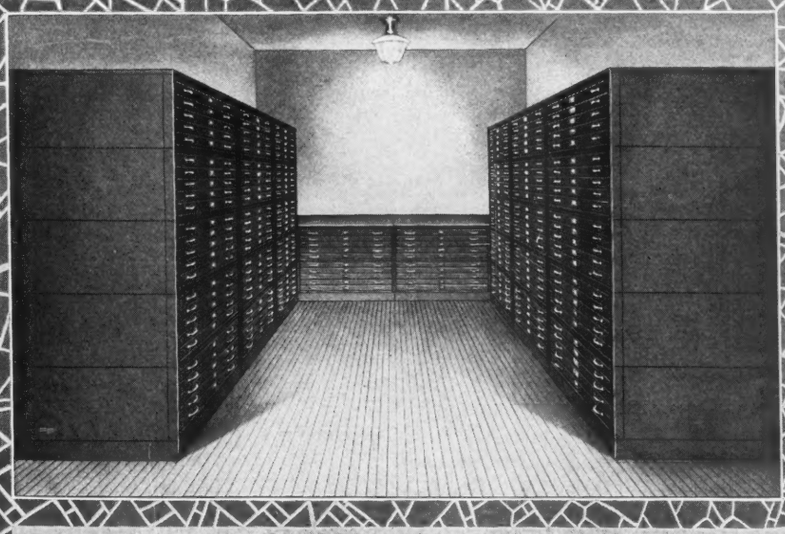

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U. S. Electrical Tool Co., Cincinnati.

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National Machinery Co., Tiffin, O.
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Jones & Laughlin Steel Corp., Pittsburgh

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Zernickow, O., Co., 21 Park Row, N. Y.

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Jones & Lamson Mch. Co., Springfield, Vt.

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Brown & Sharpe Mfg. Co., Providence.
Slocomb Co., J. T., Providence, R. I.
Starrett, L. S., Co., Athol, Mass.
Taylor-Shantz Co., Rochester, N. Y.

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Federal Products Corp., Providence.
Lowe, H. A., Cleveland, O.
Starrett, L. S., Co., Athol, Mass.
Taylor-Shantz Co., Rochester, N. Y.

GAGES, HEIGHT
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Brown & Sharpe Mfg. Co., Providence.
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Greenfield Tap & Die Corporation, Greenfield, Mass.
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Morse Twist Drill & Mch. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.

GAGES, SNAP
American Die & Tool Co., Reading, Pa.
Brown & Sharpe Mfg. Co., Providence.
Cleveland Twist Drill Co., Cleveland.
Ferner, R. Y., Co., Washington, D. C.
Greenfield Tap & Die Corporation, Greenfield, Mass.
Johansson, C. E., Inc., Div. of Ford Motor Co., Detroit.
Pratt & Whitney Co., Hartford, Conn.
Starrett, L. S., Co., Athol, Mass.
Taylor-Shantz Co., Rochester, N. Y.
Williams, J. H., & Co., 75 Spring St., New York City.

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Brown & Sharpe Mfg. Co., Providence.
Columbus Die, Tool & Machine Co., Columbus, O.
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Taylor-Shantz Co., Rochester, N. Y.

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Pratt & Whitney Co., Hartford, Conn.
Starrett, L. S., Co., Athol, Mass.

GAGES, THREAD
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Federal Products Corp., Providence.
Ferner, R. Y., Co., Washington, D. C.
Greenfield Tap & Die Corporation, Greenfield, Mass.
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Gleason Works, Rochester, N. Y.

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Gleason Works, Rochester, N. Y.

GEAR CUTTING MACHINES, SPIRAL PINION ROUGHER
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Davenport Mch. Tool Co., Inc., Rochester, N. Y.
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Manufacturers' Consulting Engineers, Syracuse, N. Y.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
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Brown & Sharpe Mfg. Co., Providence.
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Cleveland Worm & Gear Co., Cleveland.
Cloyes Gear Works, Cleveland.
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Cullman Wheel Co., 1339 Altgeld St., Chicago, Ill.
Davis, Rodney, Philadelphia.
Diefendorf Gear Corp., Syracuse, N. Y.
Earle Gear & Mch. Co., 4709 Stenton Ave., Philadelphia.
Falk Corp., Milwaukee, Wis.
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Federal Gear, Inc., Cleveland.
Fellows Gear Shaper Co., Springfield, Vt.
Ferguson Gear Co., Gastonia, N. C.
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Grant Gear Works, Inc., Boston, Mass.
Hartford Special Mchy. Co., Hartford.
Horsburgh & Scott Co., Cleveland.
Johnson, Carlyle, Machine Co., Manchester Conn.
Massachusetts Gear & Tool Co., 34 Nashua St., Woburn, Mass.
Meisel Press Mfg. Co., 948 Dorchester Ave., Boston 25, Mass.
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Newark Gear Cutting Mch. Co., Newark, N. J.
Perkins Mch. & Gear Co., Springfield, Mass.
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Poole Engineering & Machine Co., Baltimore, Md.
Simonds Mfg. Co., Pittsburgh, Pa.
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Horsburgh & Scott Co., Cleveland.
Philadelphia Gear Works, Philadelphia.
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Stahl Gear & Mch. Co., Cleveland.

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Independent Pneumatic Tool Co., 606 W. Jackson Blvd., Chicago.

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Dumore Co., 25 16th St., Racine, Wis
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U. S. Electrical Tool Co., Cincinnati.
White, S. S., Dental Mfg. Co., 150 W. 42nd St., N. Y.

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Walls Sales Corp., 96 Warren St., N. Y.

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Gallmeyer & Livingston Co., 344 Straight Ave., S. W., Grand Rapids, Mich.
Hardinge Bros., Inc., 4149 Ravenswood Ave., Chicago
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New Britain-Gridley Mch. Co., New Britain, Conn.
Ryerson, Joseph T., & Son, 2558 W. 16th St., Chicago.
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GRINDING MACHINES, CENTERLESS
Cincinnati Grinders Inc., Cincinnati.
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Geometric Tool Co., New Haven, Conn.
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GRINDING MACHINES, CHUCKING
Bryant Chucking Grinder Co., Springfield, Vt.

GRINDING MACHINES, CUTTER
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U. S. Electrical Tool Co., Cincinnati.

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GRINDING MACHINES, GEAR TOOTH
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Greenfield Tap & Die Corp., Greenfield, Mass.
Heald Machine Co., Worcester, Mass.
Landis Tool Co., Waynesboro, Pa.
Layth-Grindar Corp., Orange, N. J.
Micro Machine Co., Bettendorf, Iowa.
Modern Tool Works (Consolidated Mch. Tool Corp.) Rochester, N. Y.
U. S. Electrical Tool Co., Cincinnati.

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GRINDING MACHINES, MULTIPLE SPINDLE
Bryant Chucking Grinder Co., Springfield, Vt.

GRINDING MACHINES, PIPE THREADING DIE
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National Machinery Co., Tiffin, O.

GRINDING MACHINES, PISTON RING
Heald Machine Co., Worcester, Mass.

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Graham Mfg. Co., Providence, R. I.

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U. S. Electrical Tool Co., Cincinnati.

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Blanchard Mch. Co., 64 State St., Cambridge, Mass.
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Brown & Sharpe Mfg. Co., Providence.
Consolidated Mch. Tool Corp. of America, Rochester, N. Y.
Gallmeyer & Livingston Co., 344 Straight Ave., Grand Rapids, Mich.
Heald Machine Co., Worcester, Mass.
LaSalle Tool Co., Ottawa, Ill.
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Gorton, Geo., Mch. Co., 1109 13th St., Racine, Wis.
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Taylor-Shantz Co., Rochester, N. Y.
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Madison-Kipp Corp., Madison, Wis.

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Chicago Rawhide Mfg. Co., 1302 Elston Ave., Chicago.

HAMMERS, STEAM
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HANGERS, SHAFT
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New Departure Mfg. Co., Bristol, Conn.
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American Metal Treatment Co., Elizabeth, N. J.
Bennett Metal Treating Co., Elmwood, Conn.

HOBBING MACHINES
See Gear Cutting Machines, Helical and Spur (Hob) and Gear Cutting Machines, Worm and Worm Wheel (Hob).

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Meisselbach-Catucci Mfg. Co., Newark, N. J.
Newark Gear Cutting Mch. Co., Newark, N. J.
Union Twist Drill Co., Athol, Mass.

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Niles Tool Works Co., Hamilton, O.
Watson-Stillman Co., 107 Aldene Road, Roselle, N. J.

INDEX CENTERS
See also Milling Machines, Horizontal, Universal.
Abrasive Mch. Tool Co., East Providence, R. I.
Brown & Sharpe Mfg. Co., Providence.
Western Mch. Tool Wks., Holland, Mich.

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Davis Keyseater Co., Rochester, N. Y.
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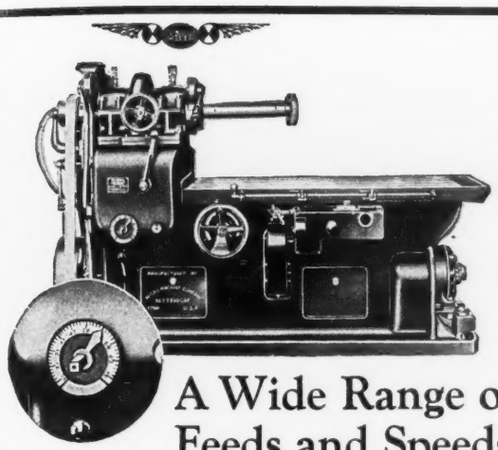

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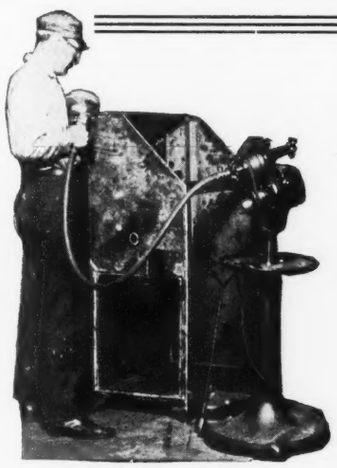

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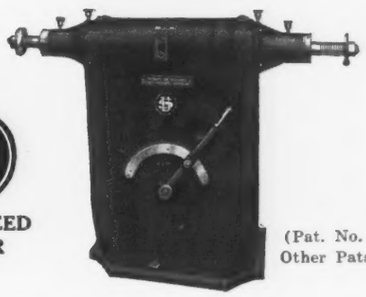

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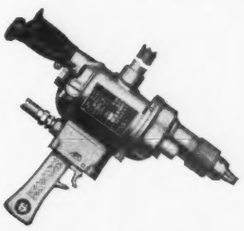

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MODEL AND EXPERIMENTAL WORK
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See heading Screw Driving and Nut Setting Equipment.

NUT TAPPERS
See Bolt and Nut Machinery.

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Houghton, E. F., & Co., Philadelphia.

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Cleveland Planer Co., 3048 Superior Ave., Cleveland.
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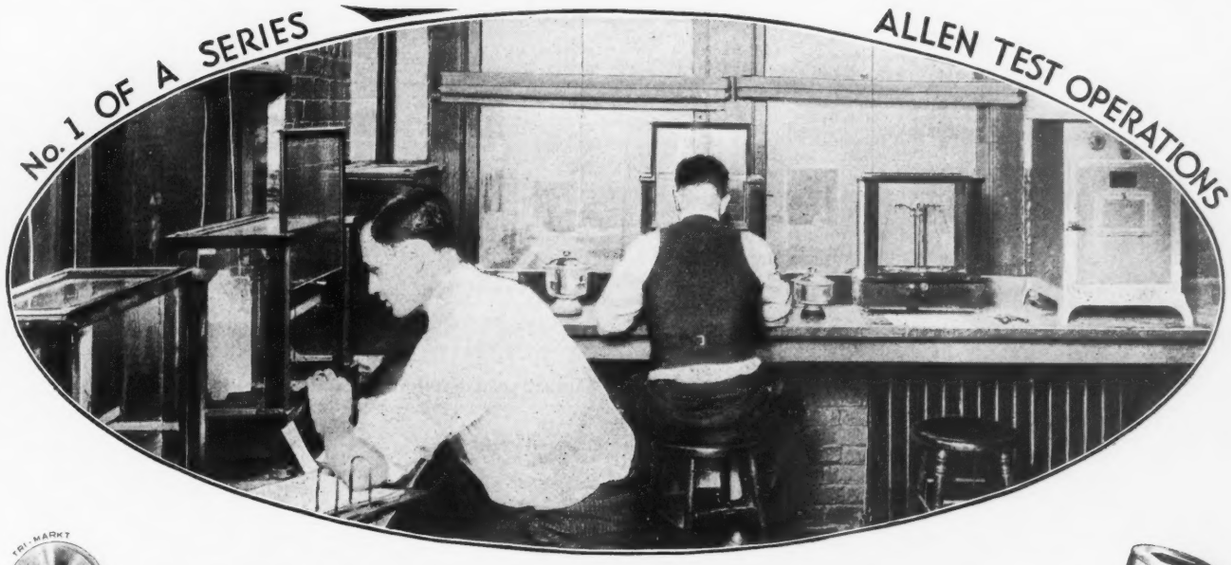

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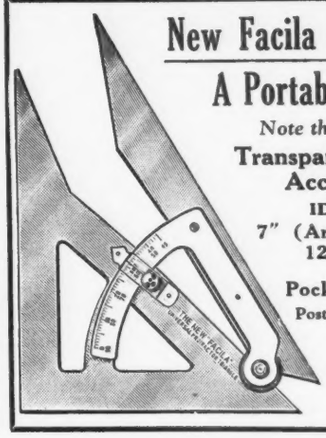

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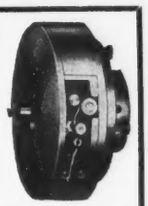

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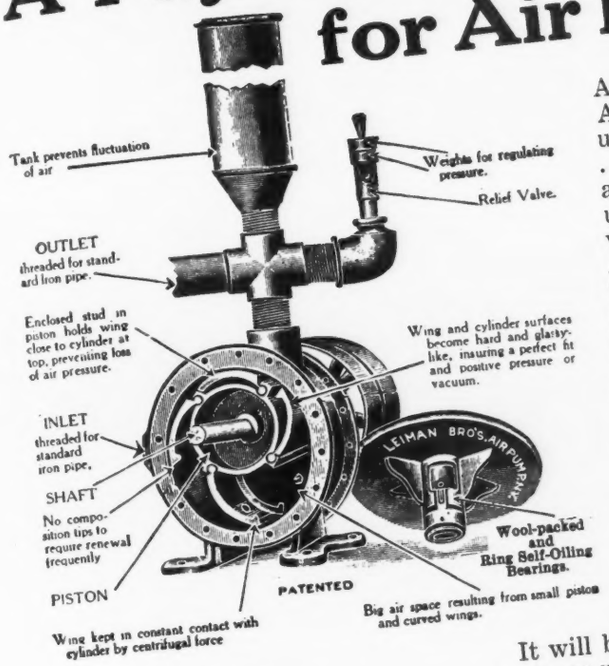
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Parker-Kalon Corp., 200 Varick St., New York.

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Automatic Mch. Co., Bridgeport, Conn.
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SEAMLESS STEEL TUBING
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Springfield Mch. Tool Co., 631 Southern Ave., Springfield, O.
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Wickes Bros., Saginaw, Mich.

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Ryerson, Joseph T., & Son, 2558 W. 16th St., Chicago.
Schatz Mfg. Co., Poughkeepsie, N. Y.
Toledo Mch. & Tool Co., Toledo, O.
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Cleveland Punch & Shear Works Co., Cleveland.
New Albany Mch. Mfg. Co., New Albany, Ind.
Niagara Mch. & Tool Wks., Buffalo.
Schatz Mfg. Co., Poughkeepsie, N. Y.
Toledo Mch. & Tool Co., Toledo, O.

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American Sheet & Tin Plate Co., Frick Bldg., Pittsburgh.
New Jersey Zinc Co., 160 Front St., New York.
Ryerson, Jos. T., & Son, 2558 W. 16th St., Chicago.

SHEET METAL WORK
New Britain-Gridley Mch. Co., New Britain, Conn.

SHELVING
See Furniture; Shop.

SHERARDIZING, ELECTRIC
General Electric Co., Schenectady, N. Y.

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Cleveland Twist Drill Co., Cleveland.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Standard Tool Co., Cleveland.
Union Twist Drill Co., Athol, Mass.

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Pease, C. F., Co., 822 No. Franklin St., Chicago, Ill.

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Jones Mch. Tool Wks., Inc., Philadelphia, Pa.
Niles Tool Works Co., Hamilton, Ohio.
Rhodes Mfg. Co., Waltham, Mass.
Sellers, Wm., & Co., Inc., Philadelphia

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Morse Twist Drill & Mch. Co., New Bedford, Mass.
Standard Tool Co., Cleveland.
Union Twist Drill Co., Athol, Mass.
Williams, J. H., & Co., 75 Spring St., New York City.

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Automatic Mch. Co., Bridgeport, Conn.
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Barnes, W. F. & John, Co., Rockford, Ill.
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Blanchard Mch. Co., 64 State St., Cambridge, Mass.
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Cleveland Auto. Mch. Co., Cleveland.
Columbia Mch. Tool Co., Hamilton, O.
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Earle Gear & Mch. Co., 4709 Stenton Ave., Philadelphia.
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Farrel-Birmingham Co., Inc., 377 Vulcan St., Buffalo, N. Y.
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Lucas Machine Tool Co., Cleveland.
Manufacturers' Consulting Engineers, Syracuse, N. Y.
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Rockford Machine Tool Co., 2412 Kishwaukee Road, Rockford, Ill.
Ruthman Machinery Co., 530 E. Front St., Cincinnati, O.
S. & S. Mch. Wks., 4541 W. Lake St., Chicago.
Shuster, F. B., Co., New Haven, Conn.
Simonds Mfg. Co., Pittsburgh, Pa
Taylor-Shantz Co., Rochester, N. Y.
Toledo Mch. & Tool Co., Toledo, O.
Union Twist Drill Co., Athol, Mass.
V & O Press Co., Hudson, N. Y.
Waltham Mch. Wks., Waltham, Mass.

SPEED REDUCERS
Adams Co., Dubuque, Iowa.
Boston Gear Works Sales Co., North Quincy, Mass.
Cleveland Worm & Gear Co., Cleveland.
Cullman Wheel Co., 1339 Altgeld St., Chicago.
Falk Corp., Milwaukee, Wis.
Farrel-Birmingham Co., Inc., 377 Vulcan St., Buffalo, N. Y.
Foote Bros. Gear & Machine Co., Dept. 37, 215 N. Curtis St., Chicago, Ill.
Grant Gear Works, Inc., Boston, Mass.
Horsburgh & Scott Co., Cleveland.
Janette Mfg. Co., 556 W. Monroe St., Chicago.
Philadelphia Gear Works, Philadelphia.
Smith, Winfield H., Inc., 116 Eaton St., Springville N. Y.

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American Hollow Boring Co., Erie, Pa.

SPINNING LATHES
See Lathes, Spinning.

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Hjorth Lathe & Tool Co., Boston, Mass.

SPROCKET CHAINS
Baldwin-Duckworth Chain Corp., Worcester and Springfield, Mass.
Boston Gear Works Sales Co., North Quincy, Mass.
Cullman Wheel Co., 1339 Altgeld St., Chicago, Ill.
Grant Gear Works, Inc., Boston, Mass.
Nuttall, R. D., Co., Pittsburgh, Pa.
Philadelphia Gear Works, Philadelphia.
Whitney Mfg. Co., Hartford, Conn.

SPROCKETS
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Boston Gear Works Sales Co., North Quincy, Mass.
Cullman Wheel Co., 1339 Altgeld St., Chicago, Ill.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Foote Bros. Gear & Machine Co., Dept. 37, 215 N. Curtis St., Chicago, Ill.
Grant Gear Works, Inc., Boston, Mass.
Hartford Special Mchy. Co., Hartford, Conn.
Massachusetts Gear & Tool Co., 34 Nashua St., Woburn, Mass.
Meisel Press Mfg. Co., 948 Dorchester Ave., Boston 25, Mass.
Newark Gear Cutting Mch. Co., Newark, N. J.
Philadelphia Gear Works, Philadelphia.
Whitney Mfg. Co., Hartford, Conn.

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New Britain-Gridley Mch. Co., New Britain, Conn.
Revere Copper and Brass Inc., 230 Park Ave., New York City.

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Noble & Westbrook Mfg. Co., Hartford, Conn.
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Schwerdtle Stamp Co., Bridgeport, Ct.

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Illinois Steel Co., 208 S. LaSalle St., Chicago.
Jones & Laughlin Steel Corp., Pittsburgh
Ryerson, Joseph T., & Son, 2558 W. 16th St., Chicago.

STEEL ALLOYS
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Ryerson, Joseph T., & Son, 2558 W. 16th St., Chicago.

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Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Ryerson, Joseph T., & Son, 2558 W. 16th St., Chicago.
Timken Roller Bearing Co., Canton, O.

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Curtis & Curtis Co., 324 Garden St., Bridgeport, Conn.
Greenfield Tap & Die Corporation, Greenfield, Mass.
Morse Twist Drill & Mch. Co., New Bedford, Mass.

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STOOLS AND CHAIRS, STEEL
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Schatz Mfg. Co., Poughkeepsie, N. Y.
Shuster, F. B., Co., New Haven, Conn.
Springfield Mch. Tool Co., 631 Southern Ave., Springfield, O.

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Errington Mechanical Laboratory, 200 Broadway, New York.
Geometric Tool Co., New Haven, Conn.
Jarvis, Chas. L., Co., Gildersleeve, Conn.

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U. S. Tool Co., Inc., Ampere, N. J.

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Etna Machine Co., Toledo, Ohio.

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General Electric Co., Schenectady, N. Y.

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Leeds & Northrup Co., Philadelphia.
Veeder-Root, Inc., Hartford, Conn.
Zernickow, O., Co., 21 Park Row, N. Y.

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National Automatic Tool Co., Richmond, Ind.
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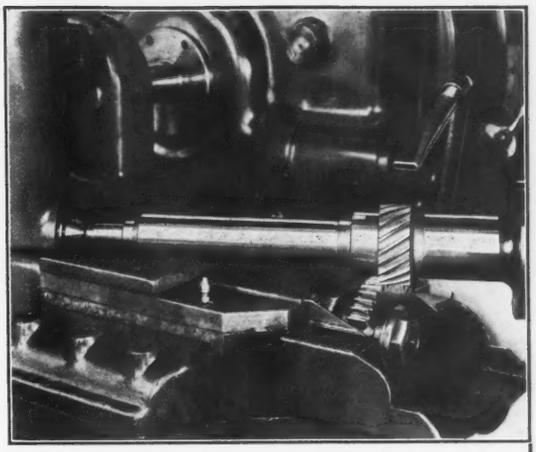

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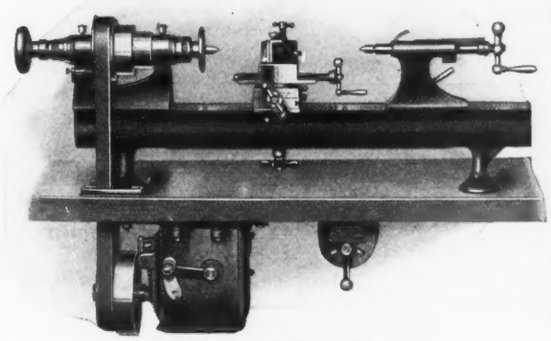

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Errington Mechanical Laboratory, 200 Broadway, New York.
Ettco Tool Co., Inc., 600 Johnson Ave., Brooklyn, N. Y.
Geometric Tool Co., New Haven, Conn.
Hoefer Mfg. Co., Freeport, Ill.
Jarvis, Chas. L., Co., Gildersleeve, Conn.
Leland-Gifford Co., Worcester, Mass.
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Brown & Sharpe Mfg. Co., Providence.
Burke Mch. Tool Co., 516 Sandusky St., Conneaut, O.
Defiance Machine Co., Defiance, O.
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Frew Machine Co., Philadelphia.
Geometric Tool Co., New Haven, Conn.
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Langelier Mfg. Co., Providence, R. I.
Leland-Gifford Co., Worcester, Mass.
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Murchey Mch. & Tool Co., 951 Porter St., Detroit.
National Machinery Co., Tiffin, O.
Rockford, Drilling Mch. Co., Rockford, Ill.
Western Mch. Tool Wks., Holland, Mich.

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Geometric Tool Co., New Haven, Conn.
Greenfield Tap & Die Corporation, Greenfield, Mass.
Hanson-Whitney Mch. Co., Hartford.
Hardinge Bros., Inc., 4149 Ravenswood Ave., Chicago.
Landis Mch. Co., Inc., Waynesboro, Pa.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Murchey Mch. & Tool Co., 951 Porter St., Detroit.
National Acme Co., Cleveland.
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Eastern Mch. Screw Corp., New Haven.
Fellows Gear Shaper Co., Springfield, Vt.
Ferner, R. Y., Co., Washington, D. C.
Geometric Tool Co., New Haven, Conn.
Grant Mfg. & Mch. Co., N. W. Station, Bridgeport, Conn.
Hall Planetary Co., Philadelphia.
H & G Wks., Eastern Mch. Screw Corp., New Haven, Conn.
Landis Mch. Co., Inc., Waynesboro, Pa.
Modern Tool Works (Consolidated Mch. Tool Corp.) Rochester, N. Y.
Murchey Mch. & Tool Co., 951 Porter St., Detroit.
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THREAD GAGES

See Gages, Thread.

THREAD MILLING MACHINES

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Hall Planetary Co., Philadelphia.
Hanson-Whitney Mfg. Co., Hartford.
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Zernickow, O., Co., 21 Park Row, N. Y.

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Jones & Laughlin Steel Corp., Pittsburgh

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Ryerson, Joseph T., & Son, 2558 W. 16th St., Chicago.
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Lovejoy Tool Co., Inc., Springfield, Vt.
O. K. Tool Co., Inc., Shelton, Conn.
Osgood, J. L., Mchy. & Tool Co., Inc., Buffalo, N. Y.
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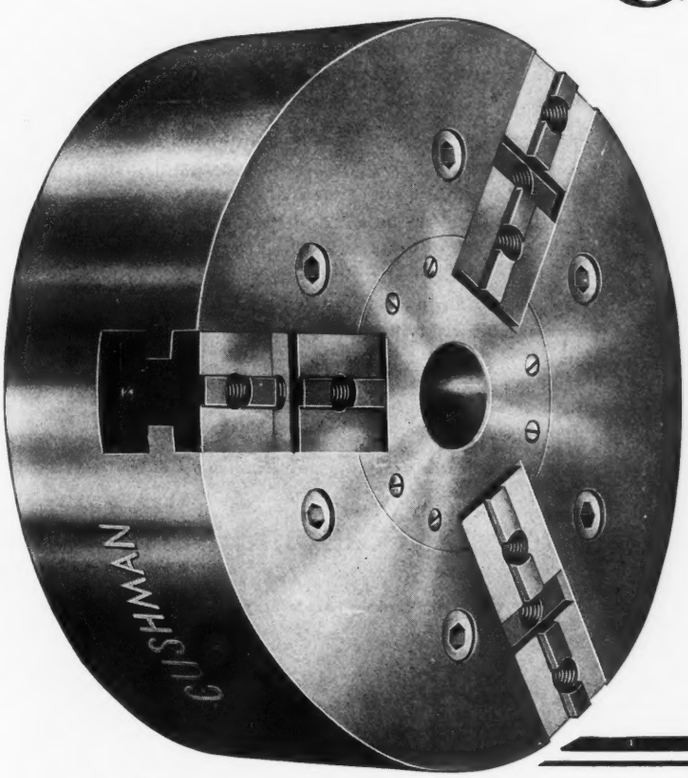

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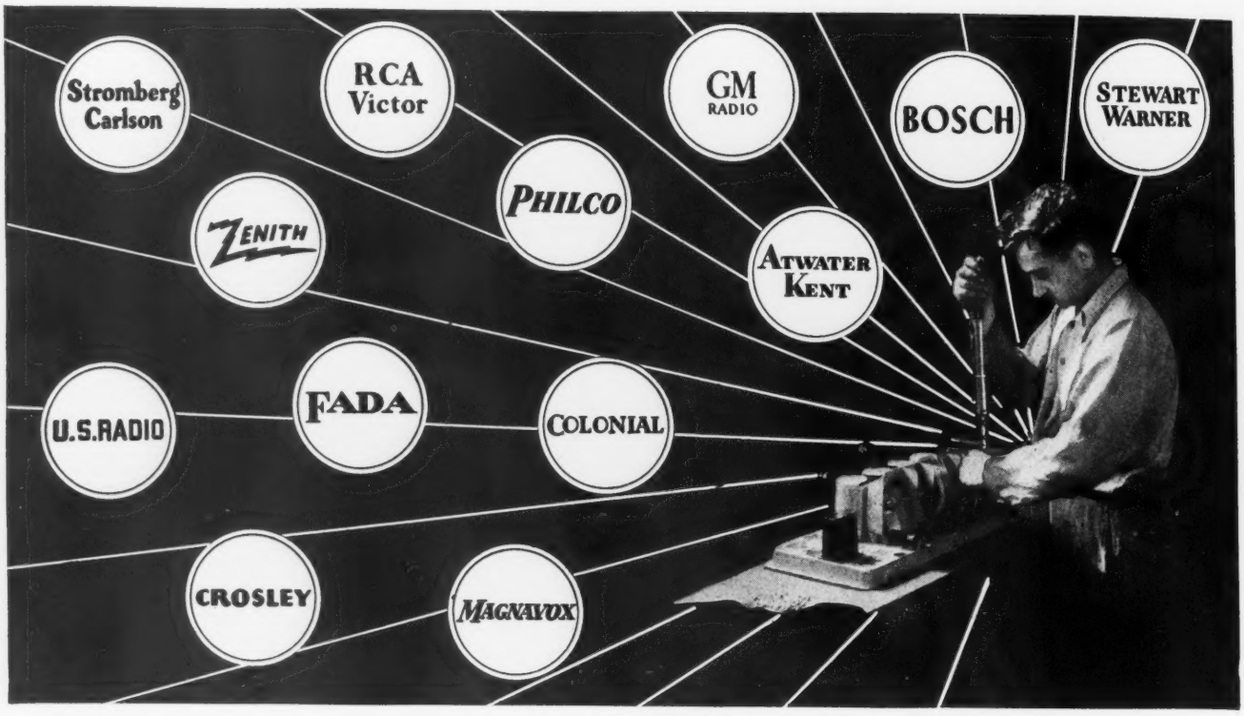

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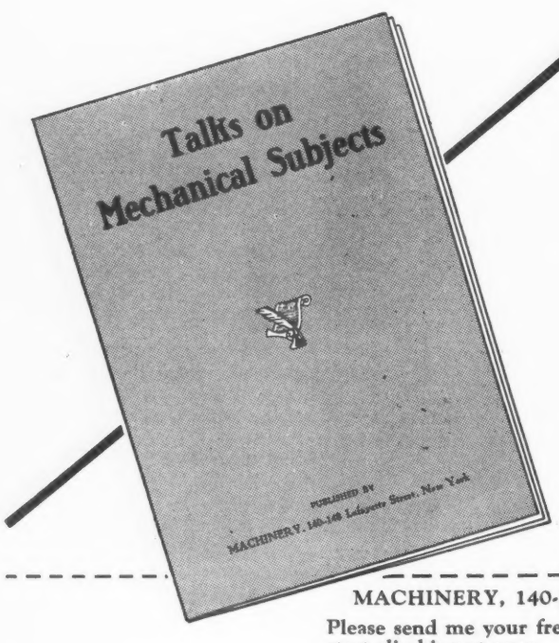

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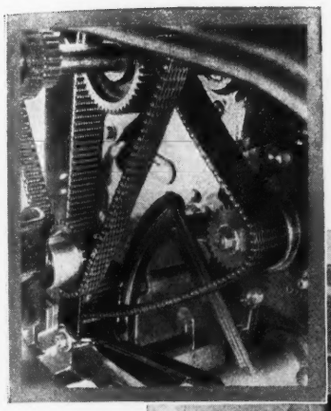

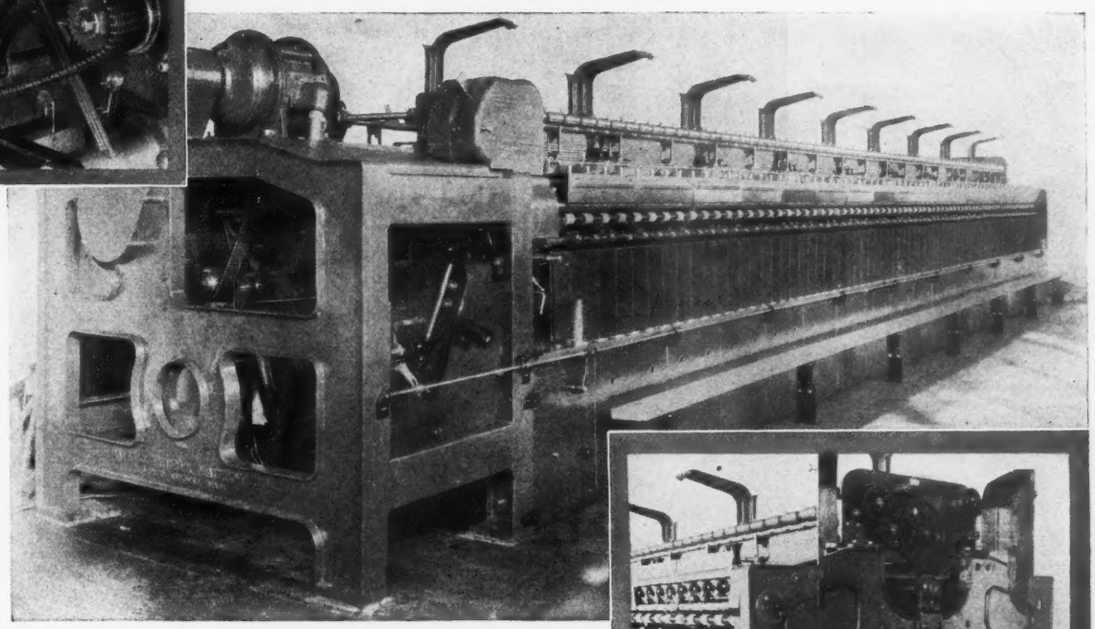

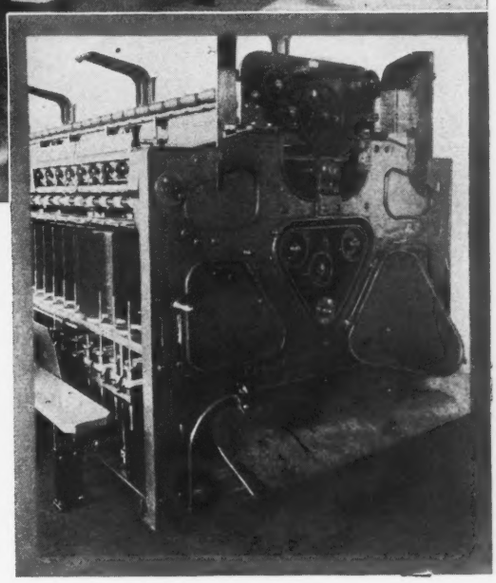

FOUR WHITNEY Silent Chain Drives transmit the power to the main and auxiliary shafts in the latest Davis & Furber Wool Spinning Frame.

The splendid performance of WHITNEY Silent Chains has justified their selection as standard equipment on all Davis & Furber equipment.

They have met the high quality standards for dependability demanded by the Davis & Furber engineers.

The double bearing joint of the WHITNEY Silent Chain ensures long life. There is no other form of drive which so successfully combines long service and positive action with satisfactory smoothness and quietness of operation.

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WHITNEY
SILENT
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Railroad Springs

have a longer fatigue life when tempered in a Horizontal HOMO

THE first horizontal Homo Tempering Furnace in industry was made for and is used by the Wm. D. Gibson Company, spring manufacturers of Chicago.

This furnace has automatically reversed, forced convection and all other exclusive Homo features. Railroad springs tempered in it show a marked increase in fatigue life over the same springs tempered in any of the old-fashioned ways. Gibson automatically secures a uniformity of Rockwell hardness that is far inside the limits set by their customers.

Production of this furnace is 6160 pounds per 8 hours, of work ranging from 500° F. to 1000° F., and the current consumption is about 234 kw.-hrs. in this case. This is a production of about 26.3 pounds per kw.-hr. The work space in this furnace is only 50″ x 25″ x 25″, and the floor space occupied is only 58″ x 69″.

Homo tempering gives just as good results on stampings, forgings, tools, machined parts, or any other production tempering or coloring job as it does on springs.

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F-254

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The wear you get from a pair of shoes is fixed by the goodness of the leather. Also, the useful service you get from your pyrometer equipment is fixed by your *thermocouples.* You need *good* thermocouples to get the right indication from your good meters. This is why, almost with no exception, the large pyrometer installations of all industry are fitted to couples made of Hoskins Chromel. They can be used above 2000°F.; they need not be packed in the protection tube, and therefore they are sensitive; they have no "immersion error"; they are so accurate as to be used on the most refined heat-treating jobs. Chromel couples hold that accuracy throughout their long useful life. When they do wear out, they can be changed "end for end," and thus give double service. You show good pyrometer judgment when you have your pyrometer manufacturer calibrate your meters for Hoskins Chromel Couples. Technical data appear in Catalog MH.

Hoskins Chromel Couples

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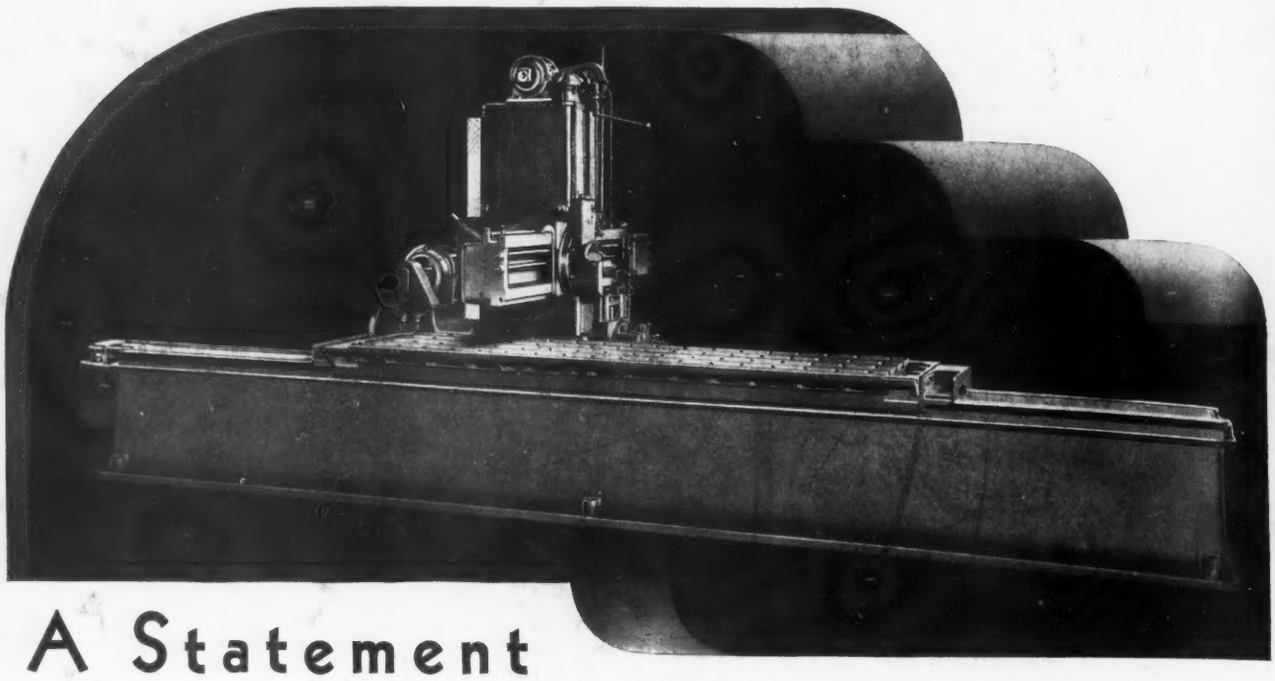

A Statement and an ANNOUNCEMENT

Pioneering in its field, the Rockford Hy-Draulic Shaper-Planer, illustrated above, is an outstanding successful machine-tool development. Not only does it reduce costs by increasing the productive capacity of the operator—it cuts down overhead by removing much more metal per horsepower, shortening set-up and operating time, lengthening the life of cutting edges, and in other ways. The successful application of hydraulic power to table-drive and feeds is responsible for this increased efficiency and output.

Several years of research and development preceded the introduction of the Hy-Draulic Shaper-Planer. Continuation of this work; study of the Hy-Draulic Shaper-Planer in commercial service, and our 25 years experience in building high grade mechanically driven shapers; now results logically in the announcement of

The Rockford Hy-Draulic SHAPER

Now in production. New throughout. Has hydraulic ram-drive and hydraulic feeds. *Compared with all-mechanical shapers, the Rockford Hy-Draulic has greater efficiency; uniform and much higher tool pressure; faster return; greater convenience; longer tool-life; lower operating cost—and a very attractive purchase price. Complete details supplied promptly—write for them today.*

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